LABORATORY FURNISHING AND SCIENTIFIC INSTRUMENT NUMBER

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVIII
No. 1243

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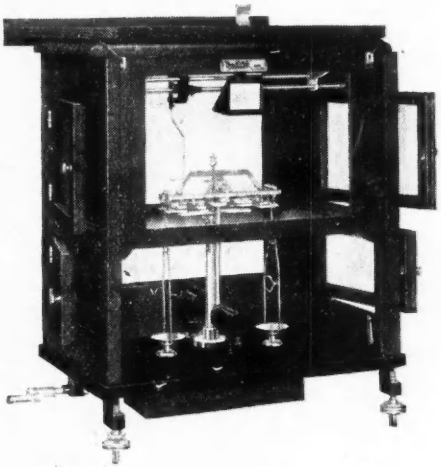

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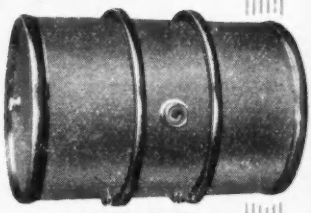

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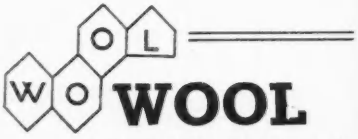

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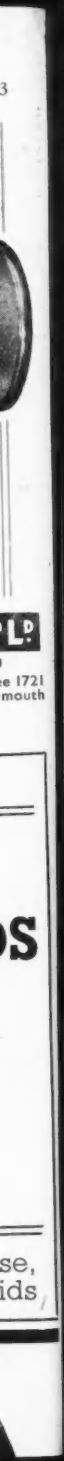

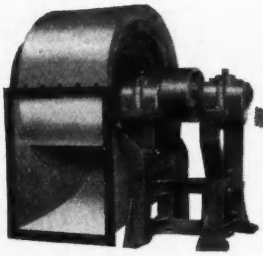

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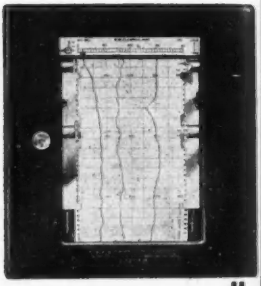

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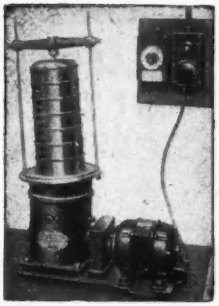

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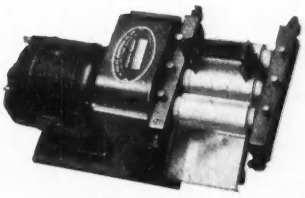

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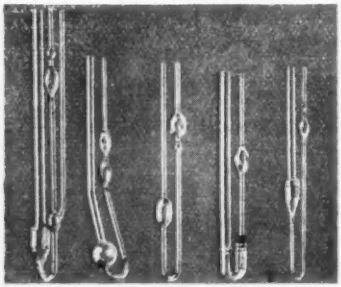

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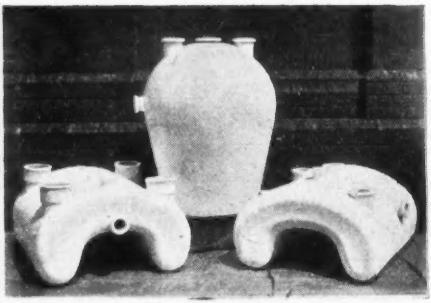

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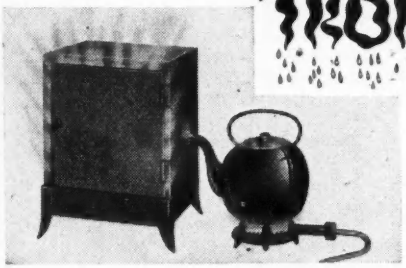

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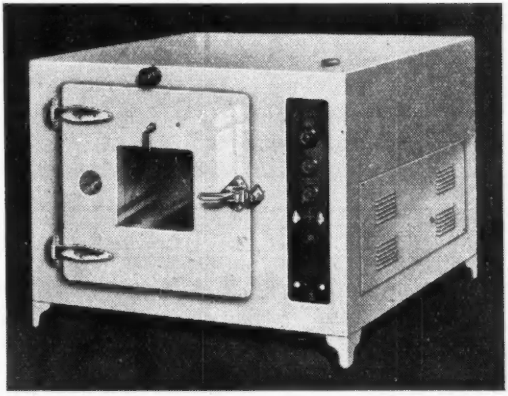

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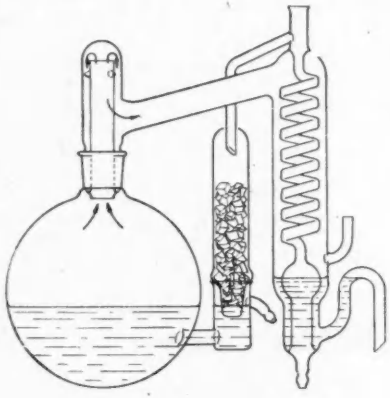

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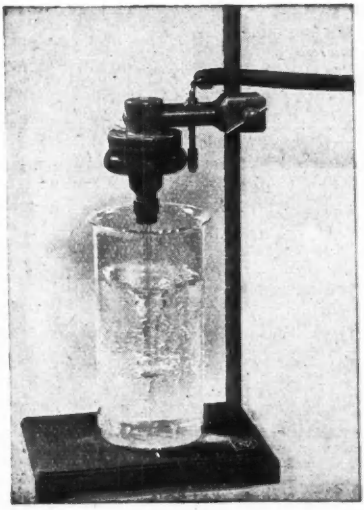

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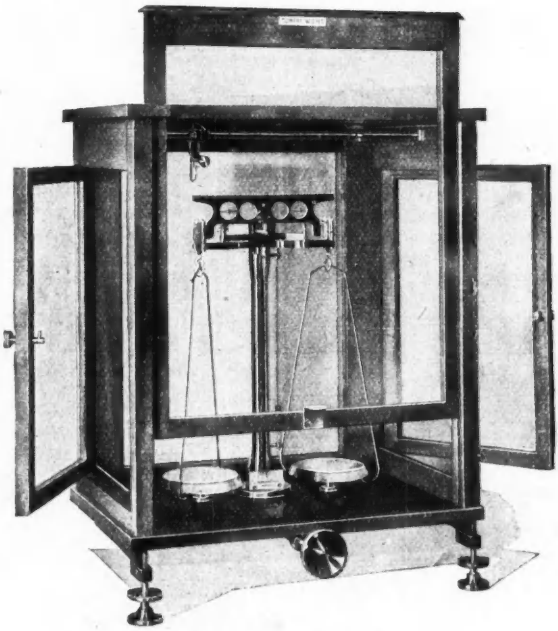

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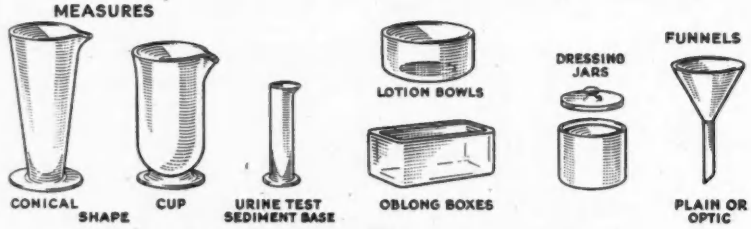

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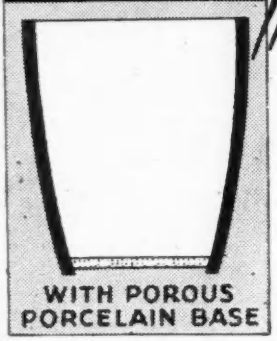

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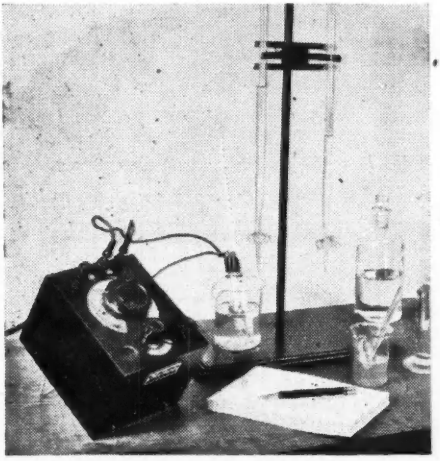

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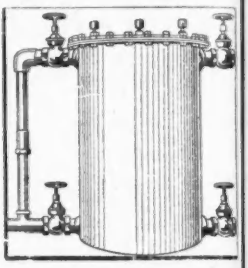

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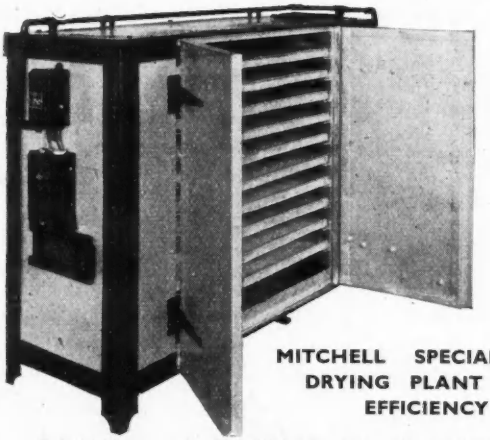

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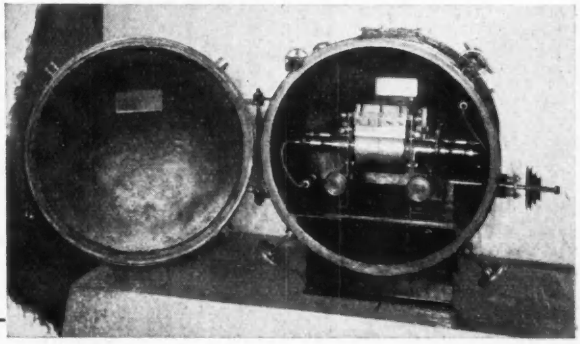

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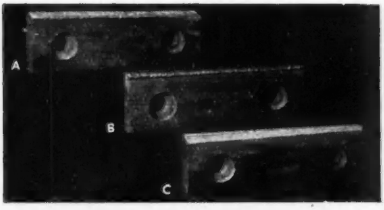

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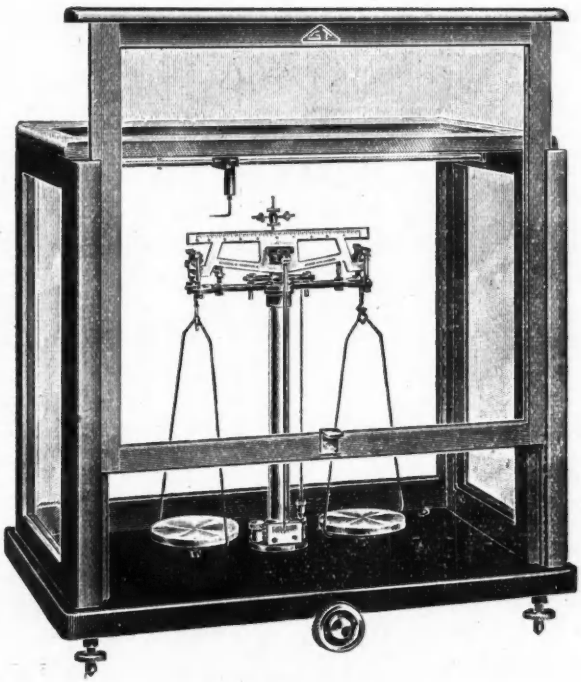

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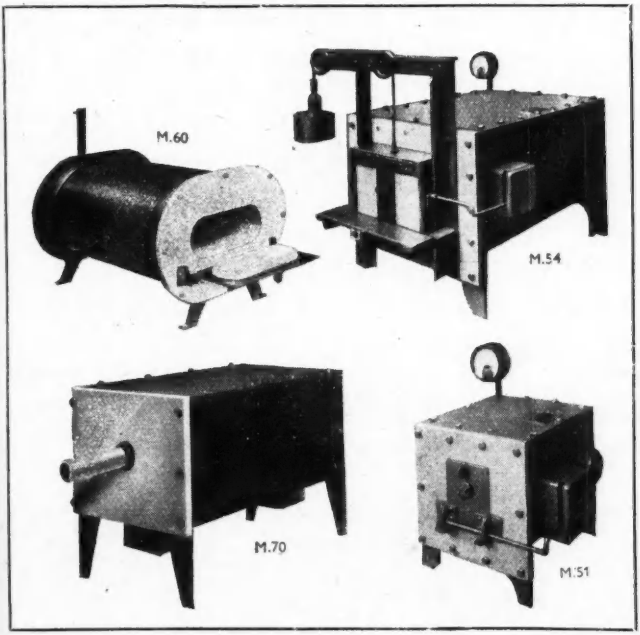

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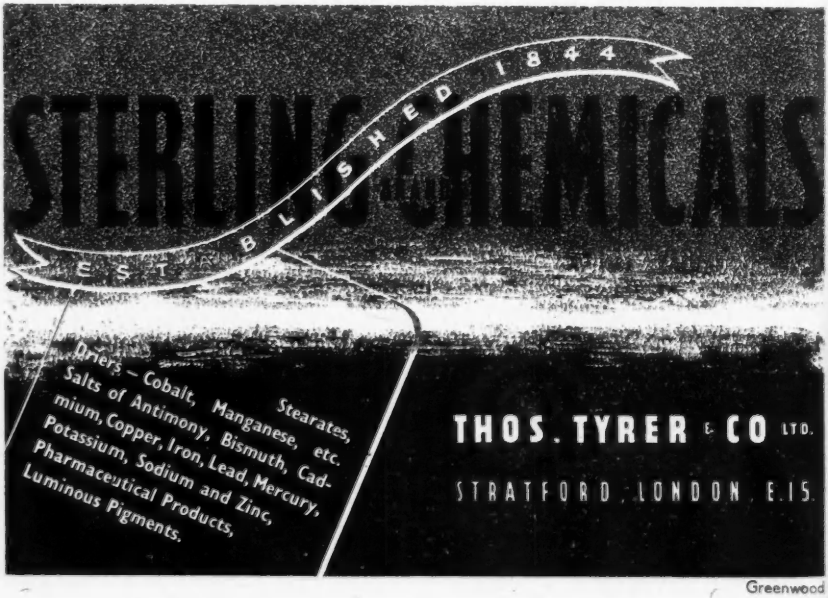
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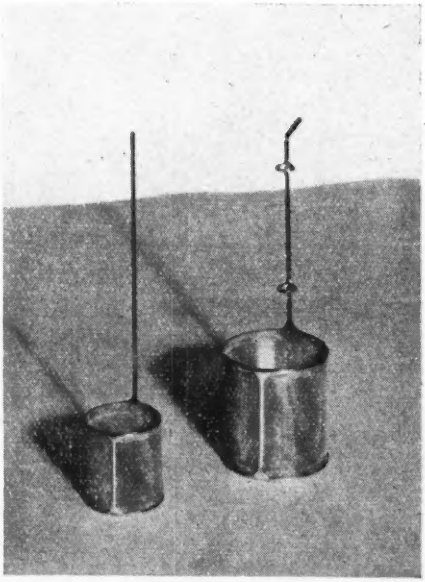

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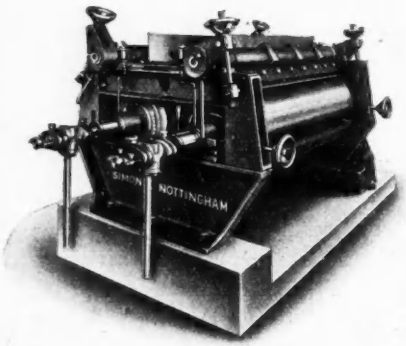

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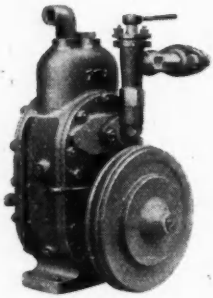

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April 24, 1943

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Instruments

THE manufacture and use of instruments is one of the most important manifestations of the rate of scientific and technical progress. The instruments employed a century ago were few and inefficient. In point of fact they were almost non-existent except in laboratories. The early steam boilers generally had no pressure gauge and no safety valve other than a mercury gauge, and this not always, through which the steam would escape if the mercury was blown out. It is not surprising that in these circumstances boiler explosions were frequent. It was a matter of considerable danger to operate a steam boiler in those days. Since then there has been a succession of great instrument designers with the result that instruments are now available for almost any essential purpose.

These instruments may be divided into several classes. There are instruments for purely testing purposes which represent the development of the early laboratory instruments in a more exact form and often of a very considerable complexity. It is a far cry from the crude instruments of 100 years ago to the precise electrometers, microscopes, balances, and many other more intricate pieces of apparatus that are now employed in scientific research or in simple testing technique. Here, generally, the purpose of the instrument is to enable a precise measurement to be made of a property of matter. The instrument is broadly the antithesis of the "practical" outlook of the Victorians. The skilled workman can still break a piece of steel and say by looking at it what is its approximate carbon content, and there is a good deal of steel still made by practical routine methods such as these. The whole business of manufacture, however, in industry generally is now not controlled by those rule-of-thumb methods which required only experience and a certain traditional knowledge handed down from one generation to another. Every manufactured article is now assessed as far as possible by some important property or by several important properties, all of which are measured by instruments. The instrument has thus become on the works side a means of precise control of raw materials, of intermediate products, and of finished goods. On the research side it is only necessary to mention instruments which have been devised to enable the quality of goods to be tested to indicate the importance of the impact of scientific

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measurement on quality. The wear on textiles, for example, can be simulated by a machine so that the accumulated wear of many months can be given to the cloth in a few hours, while a machine for accelerating weathering of concrete surfaces could give a complete "weathering cycle" once in 48 hours.

On the works, instruments are used for two main purposes. One of these is the control of conditions by indicating temperature, pressure, and other factors which may be important, in order that the operator may know exactly what is happening. A good example of the use of instruments is the boiler plant, and recent articles in THE CHEMICAL AGE have shown the extent to which instruments are now used there.

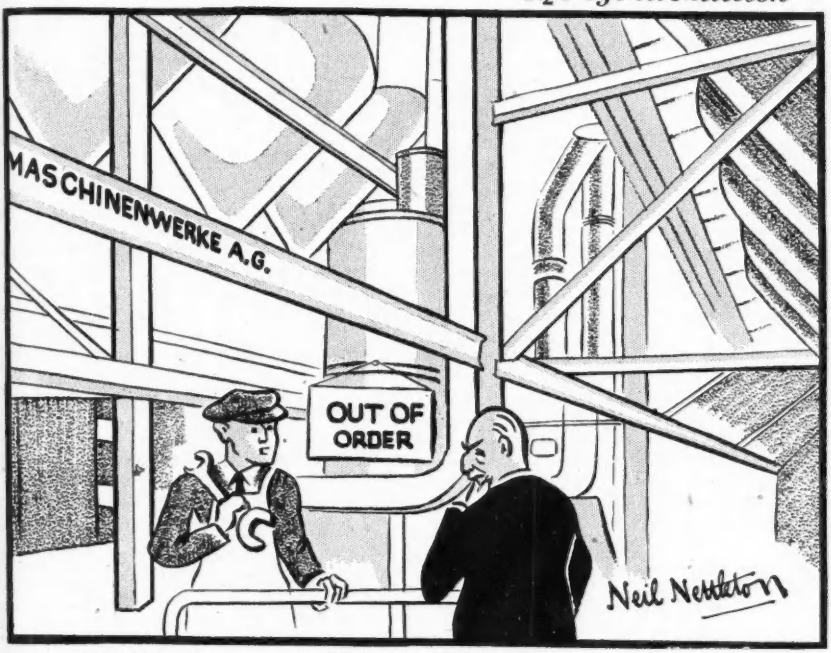
Unfortunately, while some instruments are reliable others are less trustworthy. The offenders are frequently instruments which are used for measuring purposes. The difficulty may be inherent in conditions that may not lend themselves to accurate measurement. The difficulty may again be inherent in the instrument itself. The measurement of steam and water in quantity are examples of difficult procedures and we have heard it stated, though we give the fact with reserve, that steam and water measurements on works are notoriously unreliable.

The principal difficulty in many works in regard to instruments is the fact that like other mechanical toys they are prone to get out of order. It is not always possible for the man who is guided by the instruments to know when the instrument is out of order. The difficulty may be that it goes out of order slowly and in slow stages so that imperceptibly it is reading low or high. The answer to this, of course, lies in servicing. There are large works that keep an instrument maker on the staff whose job it is to see that all the instruments are maintained in good order so that each instrument is serviced or checked regularly. In most works, however, there is no one whose sole responsibility it is to look after instruments and the job is then undertaken by the chemist or one of the engineers. When a competent man is available who really understands the instrument the servicing can usually be carried out by the works staff and no doubt this is true broadly of most chemical works. There must, however, always be some instruments that cannot readily be serviced on the works and it is by far the best practice to arrange for an instrument maker to service the instrument. Most instrument makers in normal times, and as far as possible to-day, will service their own instruments and arrangements should be made for this to be done. The need for reliability in instruments is so great that we would go to the length of suggesting that the possibility of having an instrument serviced should be an important factor in deciding which instrument should be purchased out of a selection of those offered.

Finally, there are the automatic control instruments which act as a policeman over the whole process. Control may be in regard to pressure, quantity of fluid circulated, temperature, or some other essential feature of the process. By suitably positioning the control element variations may be corrected long before it would be possible for the operators to discern the first traces of variation. There is no doubt that thermostatic control, to mention only one example, has proved to be of immense value to industry and will be extended still farther. Experience will show how far automatic control can be applied to any particular process. Here each chemical engineer in charge of a process must make his own decision. He will find excellent instruments offered to him but he must decide, often by trial and error, whether the controls effected are sufficient for his particular purpose.

While the importance of instruments in saving labour, in improving efficiency and in improving the quality of products must not be forgotten, the question of availability has nowadays to be taken into account. A mechanical war is being fought with instruments, which may be needed for the control of fighting machines, for the plant used in their manufacture, or for other service purposes. The burden of work and responsibility that has fallen upon instrument makers is heavy indeed, and in general it appears that the simpler types of instrument are all that can be obtained unless some special need, backed by very high priority, has arisen in connection with the war effort. In the circumstances it is often necessary to make do with home-made instruments and, always, above all, to take more care of instruments to-day than is deemed necessary in normal times.

N_2O by Neil Nettleton



"I think, Sir, you will find British plant best for replacements."

NOTES AND COMMENTS

Soviet Science at War

SOVIET Russia, like every other country at war, has mobilised its scientists to solve war problems. Professor Alexander Baikow, vice-president of the Soviet Academy of Sciences, summarising the scientific programme for 1943, recalls that as in the United States and Great Britain, the chief problems are presented by material resources, and researches are to be conducted for the purpose of increasing the supply of raw material for the essential war industries. The academy's geological and geographical departments are to intensify the search for new deposits of manganese, nickel, tungsten and other ores, and explorations will be carried on to discover new oil fields in the Caucasus. There is to be systematic prospecting for new coal deposits, and the production of motor fuel from coal and shale is included in the programme. Electrification of industry has long been one of the Government's major aims, and new power sources are to be developed. Industrial gas-generating stations are to be improved, and so far as possible, local resources are to be developed, so as to reduce the task of the railways. In chemistry, work will be concentrated on the industrial utilisation of raw material in the eastern regions and the production of synthetic rubber, plastics, and drugs. The Institute of Physical Chemistry announces continued studies of the theory of combustion, and an investigation into the utilisation of the chemical products of coke in eastern industrial plants. Professor Kapitza, once of Cambridge, is to carry on his work in liquefying gases, and a study of the mutual influence of Russian and English scientific literature is also planned.

Post-War Building

TWELVE of the 23 committees co-ordinated by the Directorate of Post-War Building have now submitted first draft reports, and it is expected that, by the end of the present year, all but one or two final reports will have been prepared. These study committees have been asked to consider whether their draft reports should be circulated for comment to professional and industrial organisations. Eight have adopted this course, including the Paint Committee and the Plastics Committee. A short review of the first draft report has been released with the reservation that it does not express the views of either the Ministry of Works or of the bodies responsible for convening the two committes mentioned, that is the Paint Research Association and the British Plastics Federation. It is also pointed out that this report does not carry the final approval of the committees themselves.

Cancelled Contracts

ANXIETY is being felt throughout the country by old-established small and medium-sized engineering firms at the withdrawal of labour and the virtual closing of businesses following the cancellation of contracts for munitions now in ample supply. The Engineering Industries Association has informed the Ministry of Production of the adverse effects of this anxiety, which has led firms to seek only new and higher priority work that is not likely to become redundant. It has also urged that all efficient productive capacity should be used to the fullest extent and that the smaller units are essential to give the necessary elasticity to production. It is pointed out that while considerations of major policy may, on occasion, necessitate the withdrawal of orders and the transfer of labour, this very transfer breaks up balanced "production teams" and if carried out on an extensive scale to large production units, constitutes a reversal of the tested dispersal policy. Waste, uncertainty, and the paralysis of production units which may be sorely needed after the war seem the unavoidable consequence; and it appears no unreasonable request to ask the Ministry to keep as many efficient firms as possible in being and to bring the work to the labour, rather than the labour to the work. Further, when in the national interest a firm is required to cease production on a reasonable contract, information as to why this is necessary would certainly help to remove the sense of unfairness. The Ministry's reply to these requests, is, as might be expected, polite and general. "Every endeavour" will be made to see that resources are not wasted, and "as full an explanation *as possible*" of changes of programme is stated to be in the policy of all Departments. The trouble is that such an explanation often appears to be *impossible*, and the sense of unfairness is very far from being removed.

Skilled Men for War and Peace

THE urgent need for skilled men, on which Sir Stafford Cripps has laid stress in two recent speeches, is exemplified by a little story from America, noted in the *Journal of Chemical Education*. According to a report published by the U.S. War Man-Power Commission, the want of eleven skilled men recently held up the employment of 3000 war workers. A machinery company was ready to expand; local search failed to reveal the eleven vital specialists; and the company found that, unless these men could be brought in by some means or other, only 65 new persons could be employed, instead of the 3000 for whom there was room. As the *Journal* comments, "These might have been chemists!" In this country, even nowadays, technical education is not allotted the position it deserves: snobbish folk can still be found who look down on the technical colleges, and many industrialists still refuse to release their younger employees for part-time technical study. We are almost weary of insisting that this policy is mulishly myopic, even on the lowest ground of expediency. War needs have in some sort bettered the situation, and the technical colleges, like the universities, have worked heroically to turn out the requisite number of skilled technicians. This impetus must not be lost when the war ends; but the system of education, at present directed to immediate practical ends, must be broadened to cover the "basis of general and scientific education," which Sir Stafford Cripps described.

Apparatus in Micro-Volumetric Analysis

Research Brings Variety of Inventions

by DAVID L. MASTERS, M.Sc., Ph.D.

JUST over a hundred years ago, Raspail, who was carrying out researches on starch, developed a technique by which he separated under the microscope the minute particles of which his specimens were composed, and applied chemical tests to the different portions which he had thus obtained. Although he could not have known it, he was probably the pioneer of what has become almost a separate science—that which we now know as microchemistry. It is a long way from the comparatively simple work of Raspail to the operations involving precise quantitative analysis of minute specimens which are frequently carried out to-day: but the connection is nevertheless a very real one.

Advances in Technique

For a long time the chief aim of the forerunners of to-day's microchemists were primarily concerned with improvements in technique; and outstanding advances were indeed made along this line. The best-known example of this is probably the microchemical balance, first perfected by Kuhlmann, with which everyone is nowadays familiar, and which, for many people, symbolises the whole field of microchemistry. The development of this instrument can properly be said to be an advance in technique, since it is the product of repeated endeavours to refine an existing piece of apparatus, the ordinary analytical balance. But it is none the less true to say that concentration on technique only would not have been capable of carrying microchemical work to its present state of perfection. Combined with this there has been a continuous evolution of new apparatus, entirely different from that which was already familiar for chemical operations.

As a consequence, while the microchemical balance is in many ways a replica of the ordinary analytical balance, the outsider would frequently be hard put to it to trace the resemblance between certain types of micro-distilling flasks and their chemical counterparts: or to deduce from his knowledge of ordinary burettes and pipettes the precise use and functioning of similar implements designed for use on the micro scale.

Even within the microchemical field, two pieces of apparatus apparently designed for the same purpose may be widely different in appearance and in principle. That this is so is in part due to the tendency to sub-divide microchemical work according to the order of size of the material on which the work is being carried out. Thus we can have both *centigram* and *milligram* techniques and apparatus, the former often being referred to as *semi-micro*, but nevertheless being noticeably different from the ordinary macro procedures. And, a more recent development, we may carry out *sub-micro* work, or *microgram* analysis, in which the most convenient units of mass and volume are the microgram, or 1/1000 mgm., and the cubic millimetre. This again will require entirely different treatment from any of the earlier types.

The Importance of Observation

To many microchemists, one of the most intriguing sides of their science is the ingenious construction of apparatus intended to deal with micro amounts, on these various scales. It is, of course, obvious that in a small space it is not possible to deal comprehensively with, even, all the micro-pipettes which have been found useful. This, in fact, might not be entirely profitable, for it is possible that some of them may have a limited application. But actually it is rarely the case that something may not be learned by the inspection of new microchemical apparatus, even if it appears to have no direct interest or application for the observer. For it is an important stimulus in itself to observe how any piece of apparatus resembles, differs from or is modified from existing apparatus, either macro or micro: and this is one of the greatest aids to the power of developing new and modified apparatus to suit one's own work.

This article, therefore, aims at collecting together in almost haphazard fashion

a number of recently devised examples of volumetric apparatus which illustrate the variety of invention which has gone to the making of microchemistry, and which may not be as well known as they deserve to be.

Graduated Flasks

There is less innovation in volumetric flasks used for micro work than in the other micro apparatus, but two types have been described which each have their own field of usefulness. The flask designed by Caley[1] and illustrated in Fig. 1, is intended to allow thorough mixing of the liquid in the flask, at the same time avoiding loss due to the trapping of liquid around the ground glass stopper. It is obvious that the amount of trapped liquid, which would be negligible in a volume of 250 mls., will become a source of larger error when dealing with quantities of 5 mls. or less. Therefore mixing is carried out by swirling the liquid in the large upper bulb without allowing it to come into contact with the stopper. For this purpose the upper bulb has a volume about five times that of the actual flask, or lower bulb.

The volumetric tubes of Holmes,[2] two of which are illustrated in Fig. 2, have

Fig. 1

Fig. 2.

Fig. 3.

an upper portion designed with a similar end in view, but also allowing other operations to be carried out without transfer of the material in the flask and consequent loss. Thus, precipitation, centrifuging, washing of the precipitate and subsequent solution, making up to volume, and other operations may all be performed *in situ*.

Micro-pipettes and burettes, between which there are often noticeable resemblances, vary from simple to involved designs. For moderate volumes of the order of 0.5 ml. liquid, a very simple pipette on the lines of a medicine dropper has been suggested.[3] The rubber cap is split at A (Fig. 3), and this acts as a valve. Squeezing in the direction BC enables the pipette to be filled above the mark. If the cap is then squeezed gently

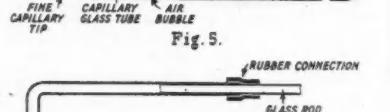


Fig. 4.

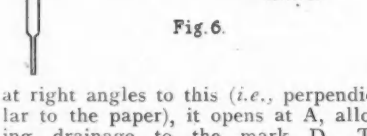


Fig. 5.

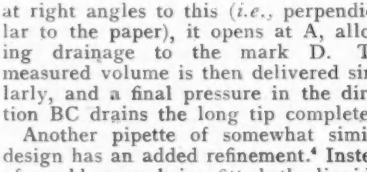


Fig. 6.

at right angles to this (*i.e.*, perpendicular to the paper), it opens at A, allowing drainage to the mark D. The measured volume is then delivered similarly, and a final pressure in the direction BC drains the long tip completely.

Another pipette of somewhat similar design has an added refinement.[4] Instead of a rubber cap being fitted, the liquid is taken in and expelled by a plunger. This plunger is itself hollow, and contains wash liquid with which the last traces of the measured liquid may be washed out of the pipette (Fig. 4).

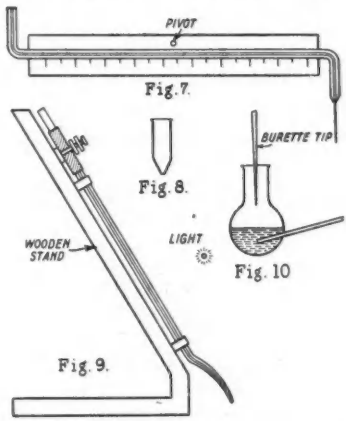
The general principle of many micro-pipettes and burettes used for smaller volumes is illustrated by the instrument employed by Benedetti-Pichler and Cefola[5] for delivering minute drops for microgram qualitative analysis. As can be seen from Fig. 5, the pipette itself is a capillary glass tube with an extremely fine tip. Liquid flow is controlled by means of a syringe which is filled with water. The water pressure communicates through a copper tube to the pipette, but dilution of the liquid for which the pipette is used is prevented by interposing a small air-bubble between the water column and the liquid in question. Drops of 0.01 to 0.001 cubic mm. may be delivered by pipettes of this type. A much more elaborate pipette of somewhat similar design has been proposed by Rosebury and van Heyningen[6]

for the production of drops of very uniform size for use in density determinations on heavy water. Control of the drop size is attained by the use of an elaborate piston system.

Burettes

Many micro-burettes are horizontal, so that there is very little head of pressure on the liquid in the tip of the burette. As a consequence no tap is required, and liquid flows from the tip of the burette either under pressure from a plunger, or on immersion under the surface of the liquid in the titration vessel, through surface tension effect. The Conway burette[7] was one of the earliest of this type, and is well-known. Hadfield[4] describes burette on a similar principle, where the liquid is expelled by a plunger, as in Fig. 6. A 3 ml. burette constructed on this principle is capable of an accuracy of ±0.001 ml., while a 0.5 ml. burette, which has the plunger ground to perfect fit inside the burette tube, is accurate to ±0.0001 ml. Hybinette and Benedetti-Pichler[8] fix their burette on a pivoted board as shown in Fig. 7. A 40 cm. length of thermometer tubing with a uniform internal bore of 2 mm. will provide an approximate capacity of 0.6 ml. As long as the tip is clear of liquid, capillary action prevents the liquid from flowing. When, however, the tip is immersed in a liquid, or is touched to a wet surface, the liquid begins to flow; and the width of the tip is adjusted so that in such circumstances the meniscus in the horizontal burette tube moves at a rate of about 15 mm. per minute, as shown on the millimetre scale at the back of the tube. The board is capable of adjustment so that this constant rate, lying between 10 and 20 mm. per minute, is always preserved, and the titrations are carried out in 2 mm. centrifuge tubes (Fig. 8) which may be stirred by a rod or by micro-bubbles of inert gas passed into the liquid. Using a magnifying glass to observe the position of the meniscus, it is possible to repeat delivered volumes to within 0.3 microlitres (thousandths of a ml.). With such a burette these workers determined by titration the silver and copper in 5 mgm. of a coin alloy. A burette operating in similar fashion has been employed[9] in the determination of nitrogen by a simple micro-diffusion method.

A very simple instrument, which is illustrated in Fig. 9, has been employed to estimate by titration the amount of salt in 0.2 mgm. portions of butter.[10] The tube is 30 cm. long, and of 7 mm. uniform bore except at the tip, and it is filled by screwing down the clamp on the rubber at the top, putting the tip of the burette under liquid, and unscrewing the clamp until the liquid rises above the top mark of a scale placed behind the burette. The burette is calibrated by weighing several lengths of mercury delivered from it. Unless the fine tip is immersed in liquid, the burette will not flow smoothly during a titration. In the estimation of the salt in butter, the chloride titration was titrated against 0.01N silver nitrate solution, using dichlorofluorescein as indicator. Since, as Hadfield points out,[4] the accuracy of a titration is dependent in the last analysis on the precision with which the end



point can be observed, apparatus has been designed to assist in this. Obviously, the most useful improvement is to lengthen the path along which light has to travel through the solution, so that the colour of the indicator is strengthened in spite of the small volume being titrated.[11] This may be done by internal reflection or by means of an apparatus such as that shown in Fig. 10. This apparatus is doubly ingenious, because the titration may first be carried well beyond the end point, and the excess liquid in the capillary, when blown back into the titration vessel, over-neutralises the excess of titrating liquid. The end point may then be approached very cautiously,

mixing in the capillary liquid with the main bulk after each addition, and observing the colour of the liquid at the end of the capillary through a lens.

This article would not be complete without a reference to the extremely ingenious titration apparatus of Wigglesworth, who devised it for titrating chloride in the body fluids of single gnats.[12] This beautiful method, which is an outstanding example of the apt use of unusual effects in the design of delicate apparatus, is not nearly so well known as it should be. A Wigglesworth pipette is shown in Fig. 11, and a burette in Fig. 12. The actual pipette tube has a total capacity of about 0.3 cubic mm. Its tip is coated, inside and outside, with paraffin wax, which enables liquid to be blown out cleanly without splashing. Above the tip, however, the pipette is not coated. As a consequence, as soon as liquid is sucked up past the paraffin, capillary attraction immediately carries it up to the end of the tube, so that the

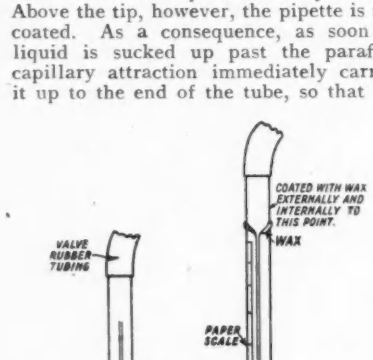


Fig. 11.

Fig. 12.

pipette always fills automatically to constant volume. The outer tube is merely a support tube in which the pipette is held by paraffin wax.

The burettes tubes are completely coated internally and externally with paraffin wax, so that there is no tendency for the liquid to adhere to the wall of the burette. The external coating, which is adventitious because of the method of coating the burette internally, is left on since it helps to show up the meniscus. On the outer supporting tube is stuck a paper scale, graduated by drawing in an arbitrary length of liquid, marking the top meniscus, drawing the liquid further up, so that the bottom meniscus now holds the position previously occupied by the top one, and again marking the level of the top, and so on. By this means, ten or more lengths which vary with the width of the tube, but which represent equal volumes, are marked off. The units in the burettes used by Wigglesworth were about 0.5 cm. long, and represented rather less than 0.04 cubic mm.

A titration is carried out on a slide, which is waxed so that a small drop of liquid on it retains a spherical shape. The drop is stirred by directing a jet of air on one side of it, so that the silver precipitate is kept spinning rapidly in the drop, but the drop itself remains in one position on the slide. The titration drop is given an appreciable size by the addition of a little water, and minute drops are blown out at the tip of a burette, and touched to the side of the rotating drop, into which they are immediately absorbed. The end point in a Volhard titration is surprisingly sharp and easy to see even on this minute scale; and without taking any undue precautions the method is capable of an accuracy of ±0.02 per cent. of sodium chloride when applied to 0.3 microlitres of fluid.

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The Board of Trade has issued a Direction (S.R. and O. 1943, No. 505) requiring every person whose name was at January 31, 1943, entered in the Home Trade Register to complete a form of return, Misc. 15, showing *inter alia* the value of controlled goods supplied by him during the standard period, June 1, 1939, to May 31, 1940, and during the restriction period, August 1, 1942, to January 31, 1943. Persons whose quota was less than £100 a month and who have given notice in writing to the Board under Article 3 (6B) of the Order need not complete this return, but will be directed individually to complete a separate form of return, Misc. 16.

Recent Developments in Laboratory Apparatus

Industrial Needs Met by Standard Equipment

by R. H. POWELL

IN this, the fourth year of war, many of the most urgent problems of production have been overcome and industry has settled down on a basis fully mobilised in the war effort. The past year has therefore seen expanding industrial laboratories being fully equipped with the greater part of their requirements in new apparatus for more rapid analytical control by methods devised with an increasing view to economy in man power. In the main these methods were developed, and plans laid for the production of the necessary apparatus, in the first three years of war. Apparatus for the rapid estimation of carbon in ferrous alloys, for the gravimetric analysis by electrochemical methods of non-ferrous alloys, for the estimation of toluene in coal-tar spirits, for high temperature furnaces to replace the German carborundum element furnaces—all these and many others are now standard equipment being turned out in quantity fully sufficient to satisfy industrial need. It may therefore be said that the British laboratory apparatus industry has accepted the challenge which war-time conditions have imposed. In the result it may feel a just pride in its achievement and a confidence in the future—so long as in that future full scope is given for the exercise of its own initiative and resourcefulness, and it is not circumscribed within a fence of bureaucratic restraint.

Nevertheless, despite concentration on the needs of war-time industry, the creative activities of pure research cannot be stilled; and much new and interesting apparatus has been conceived, to await fuller opportunity for growth and development. The apparatus described may therefore be understood as typical of many other useful laboratory instruments which will ultimately become available.

Soap Film Gas Analysis

An entirely new form of gas analysis apparatus which holds great potentialities is shown in Fig. 1. It eliminates all burette readings, all levelling bottles, all stopcocks, and reduces gas analysis to a few stop-watch readings. Its operation may be summarised as follows:—Let 100 volume units of gas be measured through an accurate gas meter A, let the gas then be passed through a reagent which completely absorbs one constituent, and let the gas then be measured in a second gas meter B. Its volume will then be found to have diminished to $100-x$, and x is the percentage of that constituent to be found from reading meter B. Similarly, if the gas be passed through a second reagent for the absorption of a second constituent, the third meter C will indicate $(100-x)-y$ and y is the percentage of the second constituent. The

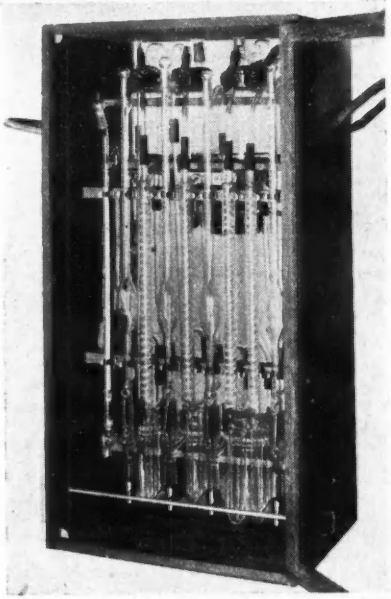


Fig. 1. Soap film gas analysis apparatus, portable model.

number of absorbers and meters may be extended to deal with any desired number of constituents. Given therefore a number of gas meters and absorbers arranged alternately in series gas analysis reduces to mere meter readings. In this apparatus (*J.S.C.I.*, 1940, *59*, 1) soap films are used as gas meters, their rate of passage between graduated marks on a glass tube, called a "calibrator" being used as a measure of the rate of gas flow. This principle is embodied in the apparatus illustrated.

Gas enters the apparatus through a small pump, which draws it from the supply line (or sampling tube) and delivers it, through a constant pressure head filled with butyl phthalate, to the first calibrator. By rock-

ing the milled knob shown at the bottom right of the case, wells containing an acidic soap solution are raised across the open ends of the calibrators and when the wells are lowered soap films are found to be travelling up the calibrators, being carried forward by the gas flow. The passage of the film is then timed between marks at the bottom and the top of the calibrator. The volume between the marks

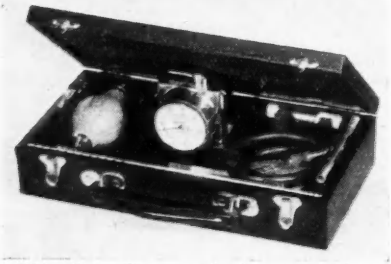


Fig. 2. Gas analysis apparatus (Microid CO_2 meter).

is known. The gas then passes from the top of calibrator 1 to the bottom of the counter-current scrubber 1, down which the first absorption reagent is flowing. For CO_2 absorption this may be 10 per cent. KOH. The gas then enters the bottom of calibrator 2 and the soap film is timed as before. The sequence continues:—scrubber 2 (chromous chloride for oxygen absorption), calibrator 3, scrubber 3 (ammoniacal cuprous chloride for CO absorption), scrubber 4 (fed with 10 per cent. H_2SO_4 for removal of traces of ammonia), calibrator 4, thence to atmosphere by a long tube to prevent back diffusion.

Four soap films have therefore to be timed. By the use of a two-handed stopwatch this operation is not so difficult as might first appear, and in one analysis of a gas containing CO_2 8.8 per cent., O_2 10.8 per cent., and CO 0.4 per cent. all the readings were completed in 166.3 secs. leaving, of course, the arithmetical work to be evaluated by a slide rule. Advantages of the apparatus are rapidity and accuracy, no parts to stick or to handle, no mercury to clean or to spill, no dead space, and the possibility of using new reagents which attack mercury and tap grease, *e.g.*, nitrating mixture for unsaturated hydrocarbons. Larger units containing up to eight calibrators will in due course be developed and will contain furnaces for combustion of hydrogen and saturated hydrocarbons.

Portable CO_2 Unit

A gas analysis apparatus of quite different type for CO_2 determination only is shown in Fig. 2. Intended for power plant superintendents, boiler house engineers and those whose work is concerned with combustion efficiency, it is a robust, portable unit containing also the essentals for sampling from flues. The Microid CO_2 meter (Brit. Patent No. 433,979) is a solid brass pressing measuring about 2¾ in. by 2½ in. by 3 in. It contains three chambers. The first, at the back, is charged with teased cotton wool, to act as an inlet filter, and is provided with a nipple for gas connection. The second, at one side, contains a removable cartridge charged with soda lime. The third, at the other side, is a precision bore cylinder in which is a closely-fitting steel ball about ⅝ in. dia., and which is free to move. A five-way stop-cock can be manipulated to connect chambers 2 and 3. A small aneroid barometer movement is mounted on the front of the case and its dial is calibrated to read up to 20 per cent. CO_2.

A gas sample is drawn through a slotted steel tube from the stack or flue by means of a rubber hand pump and is collected in a football bladder. Through a T-piece connection is made to the inlet nipple of the meter with the stop-cock set at the "fill" position. As soon as purging of the meter has been effected, the stop-cock is turned to the "test" position and, holding the meter lightly between fingers and thumb, it is inverted. Inversion causes the steel ball to fall freely from one end of its chamber to the other, and in doing so, to act as a piston and to pass the gas through the soda lime cartridge, the "test" position of the stop-cock being so arranged as to connect these two chambers. A few inversions and erections are sufficient to bring about complete absorption of the CO_2. The consequent reduction in pressure inside the closed system actuates the aneroid movement and the CO_2 concentration is immediately indicated on the dial. Less than a minute is required for the actual determination. The meter is calibrated on known gas mixtures saturated with water vapour at 23.89°C. and the dial is compensated for the effect of water vapour present in the gas sample.

Balance Desiccators

The conventional type of balance desiccator is a hollow, triangular glass prism which is designed to stand in the corner of the balance case. If charged with sulphuric acid the layer of diluted acid of lower density which forms at the surface prevents the strong acid below from exercising its full affinity for water vapour, and reduces the efficacy of the apparatus. This efficacy is not restored in full even by occasionally stirring the acid, which then becomes diluted. Very often the increase in volume due to water absorption results in overflowing of the desiccator, and flooding the balance case with acid of relatively high concentration. If calcium chloride is used, as

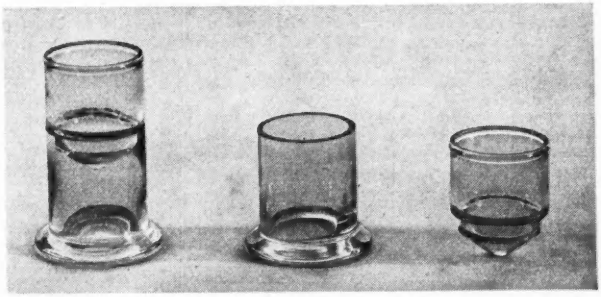


Fig. 3. A microid balance desiccator.

[Illustrations by courtesy of Griffin and Tatlock, Ltd.

soon as it commences to liquefy, the small lumps which are submerged play little part in drying and only those above the liquid level are effective. Consequently, it is common for chemists to contrive their own balance desiccators from a CO_2 flask and a small funnel charged with anhydrous calcium chloride. The saturated $CaCl_2$ solution which forms on the surface of the lumps then runs through the funnel stem and is collected in the flask below. Such an arrangement has, however, the disadvantage of instability which the Microid Balance Desiccator (Regd. Design No. 839,907) has been designed to overcome. It consists of two parts (Fig. 3), a heavy moulded base having a perforated calcium chloride receptacle nesting into it at the top. It occupies in the balance case no more room than the triangular desiccator, the liquefied $CaCl_2$ in the upper part is always fully effective for drying, and it is immediately evident when the calcium chloride is exhausted. It is readily cleaned and recharged and represents a substantial advance upon balance desiccators hitherto available.

These examples of developments carried through during war-time are a sufficient indication that the laboratory apparatus and scientific instrument industry will not be content to rest on its laurels when the war is over and when the varied requirements of the new industrial era can be fully studied.

Electrochemical Analysis

Instruments for Metallurgists

THE era of mechanised warfare has thrown a heavy strain on the metal producing industries and their associated metallurgical laboratories. Research and experiment are continually going forward, more especially in the development of new alloys designed to meet the special requirements of aircraft and other war industries. On the production side, routine analyses, in some cases amounting to hundreds a day, have to be carried out on metals and alloys and the results made available to those concerned in the shortest possible space of time. Electrochemical analysis plays an important part in these operations, and fortunately for the metallurgist, his insistent demands for more convenient and reliable instruments to meet the new situation have not remained unheeded by the manufacturer. This demand has been very largely met by Baird and Tatlock (London), Ltd., who have developed much of their special apparatus during the past two or three years, thus realising the responsibilities of makers of such apparatus in war-time.

Typical examples of modern electrolytic analysis instruments manufactured by Baird and Tatlock are the B.T.L. "Unity" apparatus designed for use with the "Sands" or other types of revolving electrodes, and their "Industrial" model which takes stationary electrodes and employs high speed independent stirring. Both types can be supplied as single units or as a bank containing any required number of units. In the latter case, the drive is contained in a single unit termed the motor unit, and the remainder, termed "slave units," linked up to the motor unit in any required number. The illustration (Fig. 1) shows a bank of five "Industrial" models, mounted on a cabinet which houses the requisite electrical equipment, *e.g.*, individual transformers, rectifiers, current-controlling rheostats, etc., all wired ready for connection to the A.C. mains. A sloping panel carries independent coarse and fine D.C. controls and a moving ammeter for each unit. Improvements have been made to their B.T.L. Aperiodic Balance (Fig. 2) more particularly in regard to the rider system. The

riders have now been reduced to three weighing 800, 400, and 200 mg., respectively, and by dropping these in different combinations on the rider arm, all weights up to 1400 mg. can be covered. As the graticule scale has a range of 200 mg., the total range covered is 1600 mg. The riders are operated by a knob situated at the side of the case and the value of the riders in position read at a glance in a window above the knob. A further improvement is the provision of normal and slow release for the beam supports by means of a single knob.

The use of Humidity Conditioning Ovens

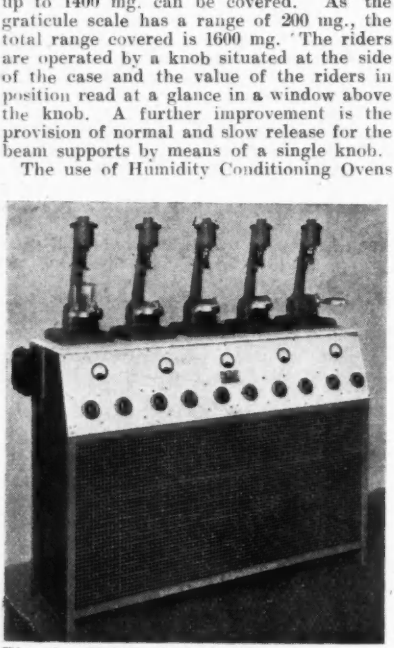


Fig. 1. B.T.L. industrial type electrolytic analysis apparatus, bank of five units.

is becoming increasingly popular in industrial laboratories, as, by its means, any material or commodity can be examined under climatic conditions approximating to those under which it will be used. Such diverse articles as resinous insulating materials, cotton, woollens, and cellular fabrics, paints and varnishes, etc., can be tested in these ovens and their reaction to hot humid atmosphere or extremes of climatic conditions studied at will. Again, many foodstuffs, *e.g.*, tea, coffee, dried or fresh fruit, which are transported through the tropics may vary their water content considerably while passing through different climates, with consequent liability to deterioration. The humidity oven enables quantitative tests to be made on such articles. Ovens with a working space up to 15 in. cube can be supplied for temperatures up to 100°C. and relative humidity up to 98 per cent. Larger ovens should only be worked up to 90 per cent. RH. when temperatures above 90°C. are required. Humidity observation may be made by either wet or dry bulb thermometer, dew point thimble, or hair type hygrometer, whichever is preferred. Modified ovens incorporating a direct reading humidity percentage balance can also be supplied.

Distilled Water Apparatus

Messrs. Baird and Tatlock have specialised for a number of years in different forms of distilled water apparatus for small industrial or laboratory purposes. They make a range of the suspended type of still, with central condenser, having from 1½ litres to

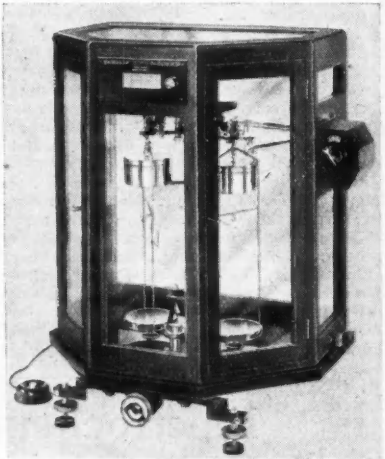


Fig. 2. B.T.L. Aperiodic balance.

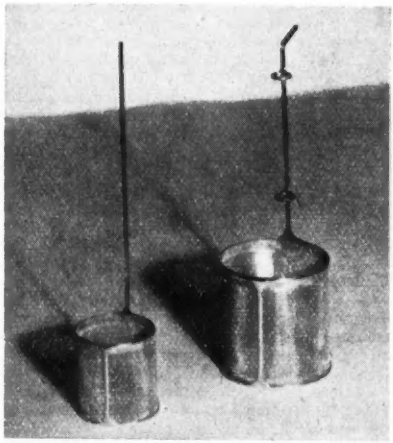
3½ gallons output per hour, arranged for gas, oil, or electric heating. These are constructed in copper with all the internal surfaces heavily tinned, and in the small sizes may be provided with resistance glass condenser tubes. There is the popular Minor Still for gas or electric heating giving up to 1 litre per hour, and a new "Utility" still of 7 in. diameter giving 1½-2 litres per hour, made specially for heating by gas, electricity, or on a primus stove. It is of simple construction in conformity with the present emergency. The lid carrying the condenser may be removed and a set of steam bath rings substituted when it is required as a boiler for other purposes. There are also two special stills, the Baraglass, an all-glass still of special construction producing 1½ litres an hour of distilled water of the highest quality for laboratory purposes, and having arrangements for positive degassing of the distillate; and the Baracop Still, an enlarged edition of the Baraglass, but having a copper boiler substituted for the flask of the latter. This still will give

up to 2.7 litres per hour and may be arranged for gas, oil or electric heating, or interchangeably. The copper construction of the boiler and the resistance glass construction of the still-head and condenser section coupled with the arrangements for continuous production of extremely pure distilled water will commend themselves to a number of laboratories.

Among other apparatus manufactured by them is the B.T.L. Portable Electric Stirrer which has a maximum speed range of 5000 r.p.m., with metal stirrers and 1800 r.p.m. by the use of a reducing gear attachment when using glass stirrers. This stirrer forms a most convenient and compact unit for use on the laboratory bench and effectively solves one of those problems often encountered when erecting this class of apparatus, *i.e.*, where to place the controlling rheostat. Unless positioned near a convenient shelf it has usually to be left on the working bench, continually in the way, and, if of the open type, exposed to risk of damage from splashes of liquid. The B.T.L. Stirrer completely overcomes this difficulty by mounting motor and rheostat alongside each other on a single stand. This construction forms a neat and tidy assembly and not only affords protection for the rheostat but also places it in a far more convenient position for manipulation. Further, as the rheostat is totally enclosed, risk of corrosion from fumes is greatly minimised, and no accumulation of dirt or dust can occur to cause irregular running of the motor. The motor itself is suitable for use either on A.C. or D.C. and has ample reserve of power for operating at low speeds. It is provided with a "Tufnol" incorrodible chuck and fitted with a plated metal tube 8 in. long, which slides through the rheostat case and can be held in any position by a pinching screw. The connecting cable between motor and rheostat passes through the centre of this tube. The whole assembly is mounted on a massive tripod base, with wrinkle finish enamel, fitted with a stout chromium plated rod. The apparatus is primarily intended for metal stirrers, but glass stirrers may also be employed, provided they are run only at low or very moderate speeds. The reducing gear attachment has been specially designed for use with glass stirrers.

Platinum Electrodes

Electrolysis, particularly as applied to the gravimetric determination of metals, is being employed on a greatly increased scale as a result of the urgent demand for rapid estimation of the constituents of alloys used for war purposes. The combined combustion and chemical method for the determination of sulphur in steel has been developed to a stage where it can be completed in a few minutes, and now electrochemical methods are in use whereby accurate determinations of copper in a variety of alloys may be executed in works laboratories in a few minutes. Dr. Sands demonstrated a great advance and considerable time saving when he introduced his rotating



J. M. C. Fischer-type gauze electrodes.

gauze anode, and although larger electrodes of more robust design are a necessity in modern practice, the fundamentals of the method remain the same in that the electrolyte is maintained at a temperature of 60-70°C., and kept in constant agitation by stirring.

Many types of electrode are in existence, and there can be little doubt that their varied forms result either from adjustment of design to suit available equipment or from personal whims of the user. Now, however, as a result of research, there is a marked tendency towards standardisation of design, combined with a fuller understanding of the electro-chemical and mechanical issues involved. While specialised applications will continue to call for platinum electrodes of differing design, there is reason to believe that from the standpoint of all round efficiency and strength the robust Fischer-type gauze electrodes will emerge from present conditions a proven type, and may well be regarded as representing a real step towards standardisation of design. J.M.C. Fischer-type gauze electrodes are made by Johnson, Matthey and Co., Ltd., of special hardened platinum. The attention given to the finer points of design and construction has resulted in a degree of rigidity and solid durability hitherto unattained in gauze electrodes of this type.

Capillary Viscometers

The Attainment of Maximum Accuracy

by L. A. STEINER

IT is now just about a hundred years since the first capillary viscometers were built. Poisseuille, although not the first investigator, made the first extensive (to-day, the classical) study of flow through narrow capillaries. He was interested in the magnitude of the forces necessary to drive blood through the body—a problem which has not yet been solved in all its details. The problem is far more complex than was imagined at that time, blood being—to use a modern term—a non-Newtonian liquid. Pure viscometry is capable of dealing with true (Newtonian) liquids only; it is a branch of a more general science, termed by Bingham "rheology." In the hundred years that have elapsed, rheological determinations have been applied to countless problems, ranging from the measurement of the consistency of an egg without breaking the shell to that of a metal just before it breaks.

It need not be elaborated that such widely different problems cannot be investigated by the use of the same instrument. Even if we restrict ourselves to pure viscometry, we have to realise that no really universal viscometer has yet been made and probably never will be. On the other hand, many of the arbitrary viscometers, made for some specific purpose, are very poor instruments from the point of view of the physicist, who prefers readings in physically correct units.

A tremendous amount of knowledge has been lost or misdirected in the past, because the instrument used expresses "viscosity" in units of its own. The readings are influenced not only by real viscosity but by a number of other factors, such as surface tension, turbulency, kinetic energy, temperature errors, volumetric and alignment errors, etc. Some of the arbitrary instruments have been subsequently standardised and it is widely assumed that a viscometer, to be trustworthy, must be of an accepted standard construction. The fact that a viscometer complies with specified dimensions is, however, not a guarantee of its proper functioning as a precision instrument (*Petroleum*, 6, April, 1943).

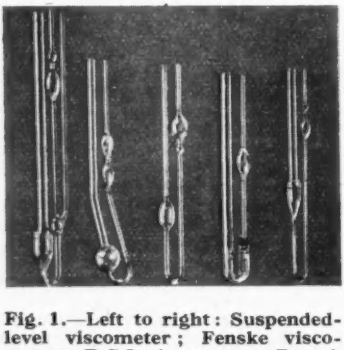


Fig. 1.—Left to right: Suspended-level viscometer; Fenske viscometer; B.S.I. viscometer; French standard pattern; Danish standard pattern.

Instead of standardising the form and some of the dimensions of a viscometer (which can hardly be exhaustive enough) it appears much more reasonable to specify a certain degree of accuracy. In the first instance the manufacturer has to comply with a formal requirement only, in the second the maker is compelled to supply a viscometer calibrated throughout its range. The present method of calibrating viscometers at one point only is not satisfactory if accuracy is required at viscosities different from that at which calibration has been made. The trend of development is to replace arbitrary viscometers by instruments which express viscosity in correct units, and the trend of standardisation is to define a certain degree of accuracy adequate for the purpose..

Viscometers of the capillary type are fully capable of expressing kinematic viscosity with a much smaller margin of error than the usual outflow viscometers such as Redwood, Saybold or Engler. The latter types have comparatively short capillaries. In general, viscometers with long capillaries approximate more nearly to the hydrodynamic requirements of viscometry than the short ones.

The unit of kinematic viscosity is the stokes, abbreviated s., dimension cm^2/sec. For low viscosities the centistokes, the hundredth part of a stokes, is usually quoted.

The British Engineering Standards Association (now British Standards Institution) was the first official body to adopt a viscometer of the capillary type as a national standard (Specification No. 188, 1923). The Institute of Petroleum gives in its latest Standard Methods three types of capillary viscometers; (a) suspended-level viscometer; (b) the Fenske viscometer; and (c) the B.S.I. tube. It is required that the apparatus used shall be capable, under proper manipulation, of measuring viscosity with an error not greater than 0.3 per cent., within the viscosity range in which it is to be used. The three viscometers mentioned are depicted in Fig. 1, in the sequence as mentioned by the Institution of Petroleum. Two other

viscometer tubes, one French, the other Danish, are included in the same figure.

The number of modifications on the Ostwald tube, the prototype of the kinematic viscometer, is very large. Generally, a viscometer tube makes a compromise between the requirements of speed, accuracy, convenience and small volume, and is greatly influenced by the other properties of the material to be tested, such as stickiness, volatility, opacity; it also depends, to some extent, on the constant-temperature bath and timing device available. Preference for a certain technique of measurement is a factor which influences the actual choice of the instrument to an extent almost equal to other considerations.

Suspended-Level Viscometer.—The difficulty of charging a viscometer accurately has been overcome, to a large extent, by Ubbelohde, who introduced the " suspended level " as a means of automatic adjustment of level. The importance of an automatic adjustment of level can best be judged by the fact that the driving head of liquid in a viscometer of the usual size is about 100 mm. (this being roughly the average difference between the position of the levels in the top and the bottom bulb). If the viscometer is charged with too much liquid, every 1 mm. difference in level makes 1 per cent. difference in efflux time. The correct adjustment of the working volume is in the normal U-tube a tedious and time-wasting operation, particularly if the liquid to be tested is highly viscous. Ubbelohde utilised the fact that a liquid flowing slowly from a capillary will follow the side walls of chamber 3, and that the level 4 will always be in the same position irrespective of the actual viscosity of the material. It is, of course, necessary for the chamber to be filled with air and for the entrance to the suspended level (*i.e.*, the joint between capillary and level chamber) to have a definite form. In Fig. 2 the top part of the level chamber, called the shoulder, is spherical; the first suspended-level viscometers had square shoulders, *i.e.*, the top surface of the level chamber was at right angles to the axis of the capillary.

In this instance the surface tension of the liquid retards the flow to an extent dependent on the curvature of the top bulb. This error may be eliminated by appropriate curvature of the level chamber. The position of the level should be independent of surface tension, viscosity and speed of flow. In order to fulfil these requirements the level chamber should be moulded and in this case times of flow can well be reproduced with a precision of 0.1 per cent., or better.

Suspended-level viscometers are more fragile than the other types. If, however, suitable fittings are used, which give additional strength to the limbs, the rate of breakage is not excessive. A suspended-level viscometer cemented into a proper fitting is far stronger than a two-limb viscometer without fitting. There is one inherent disadvantage which has not been eliminated, *i.e.*, a small error due to incomplete drainage of the top bulb. Choice of suitable calibrating liquids may reduce this error to a negligible amount, and all errors inherent to type, imperfection of manufacture, and calibration, need not exceed ±0.2 per cent.

Fenske Viscometer.—The second of the viscometers in Fig. 1 has been developed in the United States by Fenske and his collaborators and is known there as the Modified Ostwald Viscometer, a term which is not very precise. By placing the bottom bulb under the top one, errors due to misalignment have been very much reduced. The viscometer is

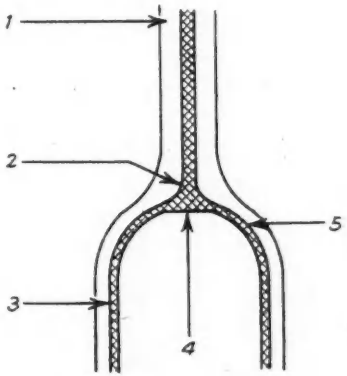


Fig. 2.—Spherical shoulder of suspended-level viscometer: (1) Capillary, (2) outlet, (3) liquid flowing down walls, (4) position of level, (5) spherical shoulder.

charged in the inverted position by filling the first two bulbs, suction being applied through the wide limb. This method of filling is very convenient, but it leaves no possibility of supervising the correctness of the filling, and any error which may have been made by the operator remains undetected. The calibration constant varies with temperature; accurate calibration involves a great expenditure of time. Errors due to drainage are appreciable and depend on the time elapsed between filling and measurement. In the first viscometers of this type the two limbs were connected by a glass bridge. This easily introduces an undesirable strain into the glass walls which may effect the strength of the instrument several months after completion. Metal bridges cemented to both limbs introduce no strain into the viscometer and improve its mechanical strength. On the whole, the Fenske viscometer is handy, robust, and rapid in operation, and can well be entrusted

to unskilled personnel, if moderate accuracy is sufficient. If the requisite time is spent on its calibration and operation, a very high degree of precision can be achieved with this instrument. In routine work, however, accuracy is often sacrificed to speed.

U-tube Viscometer.—There is not much to be said here concerning this type of viscometer, except that the viscometer of the Institute of Petroleum, while in most dimensions identical with B.S.I. Standard No. 188, is so far different from its original, that an overall accuracy of 0.3 per cent.. is required. It has been shown lately that two viscometers which are identical at one point, say at 30 centistokes, are not necessarily identical at 100 centistokes. With some care in the manufacture this error and others may be eliminated and an overall precision of 0.2 per cent. is quite attainable. Accuracy has seldom been found a disadvantage and it is also probable that other materials besides petroleum products will benefit from improved technique in viscosity measurement.

F.B.I. Meeting

Lord Dudley Gordon's Speech

AT the annual general meeting of the Federation of British Industries last week, Lord Dudley Gordon, the retiring President, reviewed the Federation's work during his term of office and spoke of some problems facing industry in the future. He referred to the Federation's part, at the Government's request, in the work of the National Production Advisory Council, and pointed out that membership of the Federation had reached a figure never previously attained. In his view, one of the reasons for this support was the democratic nature of the Federation's constitution, as they had secured the representation of all sections of industry, both large and small.

The Prime Minister, said Lord Dudley Gordon, in his broadcast speech on reconstruction had been careful to remind his hearers that we were a long way yet from winning the war and that our energies must be devoted first and foremost to its success. "At the same time," said Lord Dudley Gordon, "it is vitally important that we shall not be caught unawares and that plans of a preliminary nature should be drawn up containing sufficient flexibility to enable them to be shaped and applied to the circumstances as they will be when the time comes for putting them in operation. Members of the Federation demanded that such plans as were made should assume the continuance of individual enterprise. Our industrial organisation must be built on the basis of co-operation of individuals."

On the question of the future finance of industry, Lord Dudley Gordon said the Federation had recently made representations to the Chancellor of the Exchequer. "There is," he said, "undoubtedly a feeling of uneasiness in industry owing to the fact that the incidence of war-time taxation is likely to leave industry without the resources to fulfil the obligations which will be laid upon it, not merely to produce the necessities of life, but to provide steady employment for the great mass of the population."

"We cannot reconstitute and increase our export trade," he added, "without agreed arrangements with overseas countries. This applies with particular force to the United States of America as well as to the British Empire countries, and complete arrangements cannot be made without the inclusion and co-operation of our Russian allies; but we need not enter a conference of the nations in this matter in the least degree in the form of suppliants. We are the world's greatest customer, and the nations of the world must see to it that their best customer is able to purchase from them, or they will themselves be in want. The contribution of the industry of this country towards future world prosperity is one of prime importance, and those who speak for the nation in international affairs will have to make it clear that it is upon us and our ability to purchase that the even flow of trade throughout the world will largely depend."

Partial Pyrolysis of Wood

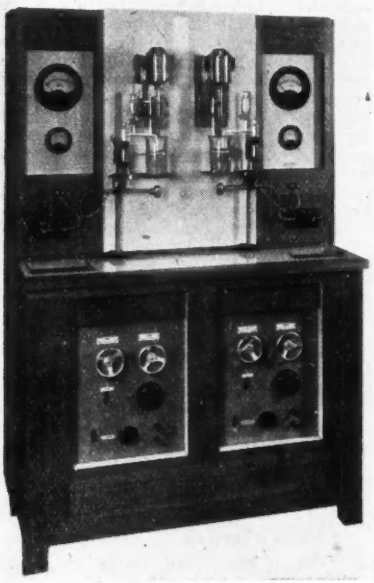
New Products Forecast

WOOD distillation has traditionally yielded three major products—charcoal, methanol and acetic acid. R. W. Merritt and A. A. White, of the University of Michigan, in a paper entitled "Partial Pyrolysis of Wood" (*Ind. Eng. Chem.*, March, 1943, p. 297) suggest the possibilities of an industry with two different major products—acids and modified wood residue—obtainable by partial pyrolysis in an atmosphere of superheated steam at temperatures below 260°C. The authors consider the temperature range of 240°-260°C. to be critical in that the exothermic reaction which accompanies wood distillation begins to start there, and in commercial carbonisation this rapidly raises the temperature to the neighbourhood of 400°C. The damping influence of steam prevents any uncontrolled rise in temperature. At 240°C. it was found that the liquid products of distillation contained 80 per cent. of the maximum yield of acetic acid with considerable additional amounts of formic and propionic acids, but no methanol. This result is in contrast to the products from a typical commercial plant which yielded only 80 per cent. as much acetic acid and only a small fraction as much formic and propionic acids as from partial pyrolysis with steam.

Control and Measuring Instruments

Thermostatic Progress : Novel Apparatus

A CONSIDERABLE amount of research has been done during the war on certain special aspects of scientific research and control apparatus. The aspect which has received the most attention is thermostatic control, and accurate robust pressure measuring instruments. Both of these problems have caused Townson and Mercer, Ltd., of Croydon, to produce some very novel apparatus, but apart from these, a considerable number of their other instruments have been improved. Enormous advances have been made in the design of the Electrolytic Analysis Apparatus since pre-war days. The whole apparatus is designed

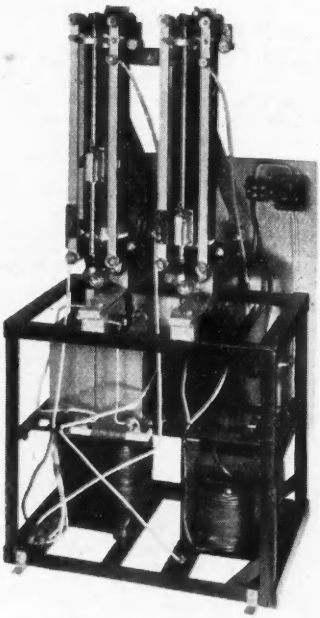


Front of two-head research electrolytic analysis apparatus.

to work in an atmosphere of corrosive fumes from the beakers, continuously, 24 hours a day for months on end. The instruments are versatile and can be used with reversed polarity or variable voltages and amperages. Their Mark II model now in production proves most effective where compressed air is available, the place of the electric motor being taken by a compressed air turbine made in plastic with a stainless steel sheath.

An instrument with two heads designed specifically for research purposes is the Research Electrolytic Analysis apparatus. Electrolyte is under continual measurement with a special calomel electrode on a swinging arm, working an enclosed 250,000 ohm voltmeter. The output is up to 10 amps. at 10 volts through the electrolyte, and provision is made for keeping the electrolyte hot and for exceptionally accurate measurement and control of all conditions.

The " Turbinia " compressed air turbine is a type of machine which gives appreciable power at very low speeds, if required. The chuck for holding the stirrers is of



Removable control gear for two-head research electrolytic analysis apparatus.

unusual design and does not incorporate any metal parts. Only the jet tube and holder are of metal and these are of stainless steel. The firm are the makers of " Phoenix 60 " funnels, which, because of their smooth inner surface, ensure an air-

tight joint between the paper and the funnel and enable an appreciable pull to be exerted by the column of water in the capillary stem. They are now putting out a standardised and simple article in the way of steam-heated water baths, and are finding a demand for their metal desiccator cupboards, two sizes of which are normally available, and appear to cover the average requirements of laboratories.

Thermostatic Equipment

Messrs. Townson and Mercer are makers of Spring Condenser Clamps, which permit a slight sideways movement for using with standard ground joint apparatus, and they have made major improvements in all their retort stands, etc. Their retort-stand rods are electro-zinc plated and doped with lanoline, without extra charge. Much work has been done by them on thermostats, both for air and water. The L.T. Thermostat Bath is the culmination of 18 months' research on various types of liquid temperature control, and is a very versatile instrument. The fundamental difference lies in the method of water circulation. The heat interchanger employs a weir system, whereby columns of water flow in parallel. Various types of heater can be used, depending on the accuracy required, and the bath can be got down to approximately $\pm 0.001°C.$, if necessary, for special purposes. A great deal of other work has also been done with special thermostatic baths. The latest work has been on gas regulators which are being correspondingly modernised. With regard to air-temperature control, a number of unusual thermostatically controlled air ovens have been produced, the most spectacular being the L.T. Air Circulated Constant Temperature Oven. It is a multi-layer oven, giving a constancy of temperature throughout with a number of unique features. Other and cheaper ovens have also been produced which embody forced air circulation, but on a different principle. A wide range of manometers have been made for industry in general, the majority of which are of the " U " type, considered essential for accurate work. For vitamin production they have produced a considerable number of the small " U " tube gauge, giving pressures from zero up to 20 cm., which are excellent for ordinary commercial distillation, etc. During the year it was discovered there was a real need for an instrument which would measure temperature at a particular point, especially in regard to the temperature of liquids flowing in pipelines. The ordinary bulb type thermometer integrates the temperature over too big an area, and a needle-point thermocouple of robust type was finally produced, the accuracy of which is very high, and some interesting results have been obtained.

U.S. CONTROL APPARATUS

Modern Precision is the title of a booklet issued by the Leeds and Northrup Co., 4908 Stenton Avenue, Phila., dealing with apparatus and equipment for measurement or control in laboratory, plant, or field. Micromax Pyrometers are among the apparatus mentioned, and these are made in five models for either thermocouples or Rayotube radiation detecting elements. The Micromax Gas Analysis Recorder, which is said to provide effective protection against inflammable mixtures of hydrogen and oxygen, is illustrated in a Process Industries section, which also contains particulars of the Micromax Control for sulphur burning. For the latter it is claimed " that this recently developed controller regulates the secondary air valve of a sulphur burner so accurately and continuously that the per cent. SO_2 is held practically at the desired maximum. It measures SO_2 directly and, when a deviation from desired strength begins to appear, it opens or closes the air valve by an amount which is proportional to the deviation. Being a proportional controller, and resetting itself when changes in load, lag, etc., develop, its ' micro-responsive ' quality has full effect, and extremely small changes in SO_2 actuate the valve." Other sections in the booklet refer to temperature control equipment for the ceramics, metals, and oil industries, and for power plants, while some pages are devoted to a research, teaching, and testing section.

RADIO-ACTIVITY ANALYSIS

Radio-activity is now being used to determine the amount of potassium in fertilisers and other mixtures. The new method, which is claimed to be accurate, may completely replace the slow and laborious chemical analysis, until now the only general method in use. The new method, which employs the Geiger counter, is the result of research done by two American scientists, Dr. R. Bowling Barnes and Dr. D. J. Salley, of the American Cyanamid Company. Potassium mixtures and compounds possess the property of radio-activity to a slight degree. In the new method the quantity of potassium present is determined by the intensity of the radio-activity of the mixture, which, though weak, is measurable by extremely sensitive modern physical instruments. The sample of the mixture containing potassium is dissolved in water, with or without the assistance of an acid, and introduced into a special glass cell which surrounds the Geiger counter tube. The tiny impulses caused by the radio-active changes in the potassium atoms of the sample actuate the counting apparatus.

Manufacturers Further War Effort

New Types of Furnishings and Instruments

BRITISH manufacturers of laboratory ware have undoubtedly continued to play their part during the past year in furthering the national war effort, because preliminary research must take place in the laboratories before a finished product can be turned out in quantity. The Thermal Syndicate, Ltd., Wallsend, Northumberland, are in a strong position as regards supplying their Vitreosil, pure fused silica, laboratory ware. Priority requirements for the war effort naturally take precedence and such classifications when indicated on orders are a help in speeding delivery, particularly if controlled materials other than Vitreosil are to be incorporated into apparatus being made. Apart from the normal run of laboratory vessels, crucibles, basins, etc., made-up apparatus in Vitreosil is a speciality of the company, many of whose workers have had years of experience in making the most complicated research apparatus. The new refractories department of the company's factory is now producing a greater variety of products from their special Fused Alumina and pure Fused Magnesia. These materials and products are for use at temperatures beyond the range of Vitreosil, *e.g.*, up to the region of 2000° C. Alumina laboratory ware in both dense and porous varieties is being produced, the latter including a range of *ignitable* porous alumina thimbles for Soxhlet extraction work and gas-borne testing apparatus. Refractory and electrically insulating cements, consisting largely of the above-mentioned fused materials, are available for a wide range of conditions. Materials formerly imported are thus replaced by home-produced products and the country's war effort helped by saving shipping space. Announcements of the company's new products are advertised in this journal, and every attention will be given to reader's inquiries. These should be accompanied with as much information as possible on the conditions of use so that valuable time may be saved in submitting recommendations.

Stabilising Electrical Units

"Advance" Constant Voltage Transformers, special transformers manufactured by Advance Components, Ltd., of Waltham-stow, are fulfilling a long felt demand for stabilisation of A.C. supplies, and they are now being successfully used in practically every branch of industry. During the present emergency, however, the firm is only manufacturing models giving outputs up to 150 watts, but designs have been prepared and they will eventually produce models giving outputs up to 2 kW, and perhaps higher. The transformers can be designed to operate at any load up to 2 kVA. and any power factor leading or lagging. The output voltage can be made to fall when

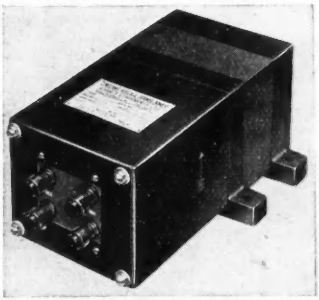


Fig. 1. Constant voltage transformer by Advance Components, Ltd.

the primary voltage rises, but generally, however, the essential requirement is that the voltage should remain constant at all times irrespective of changes in primary voltage or load. Part of the transformer operates at a high flux density, and this results in some distortion of the output voltage. The distortion varies with the primary voltage and is a minimum when the primary voltage is low. For all ordinary purposes such as the stabilisation of signal generators, valve voltmeters, light sources, etc., the wave distortion is important. The transformers are normally adjusted to give constant R.M.S. voltage, although they can be supplied to give constant average voltage. Owing to the distorted wave form a voltmeter that is independent of frequency up to 500 cycles must be used to measure the output voltage, and a thermal meter would be a suitable type. Where larger outputs than 150 watts are desired, transformers can be operated in parallel; for instance, if an output of 360 watt is desired, three 150 watt transformers can be operated in parallel. The regulation of the transformers in parallel will be exactly the same as for one transformer. Among the Constant Voltage Transformers manufactured to order is the unit type T.U.4 designed to operate *p*H meters, but having many other applications. With a constancy load of 100 mA, the output voltage (nominally 12 V) will not vary more than ± 0.2 per cent. for a variation of ± 15 per cent. primary voltage.

An interesting range of research and

pilot plant scale drying units is being supplied by Messrs. L. A. Mitchell, Ltd., the Manchester consulting and chemical engineers and industrial drying specialists.

Drying Cabinets

To meet the demand three types are offered to suit different purposes, namely, the hot air recirculation drying cabinet, the film drum type of dryer arranged for atmospheric and vacuum operation, and the small vacuum tray dryer. Drying cabinets are supplied in two sizes, one for accommodating for standard purposes 10 trays, 32 in. by 16 in. spaced 8 in. apart, and another accommodating 20 trays of the same size and at the same spacing. They are available for steam, electric or gas heating, with thermostatic control if necessary, and give results in operation which are easily translated on to full scale production practice. These cabinets are also being used quite widely for drying small productions of valuable materials, and represent a compact and useful arrangement for this purpose. The small film dryers are for the experimental drying of solutions and suspensions, and different arrangements as to feed and drum disposition are available.

Increased production to meet the requirements of laboratories engaged on important work has been the keynote for the firm of J. W. Towers and Co., Ltd., Widnes, during the past year. Greater output and better quality has been their aim rather than the introduction of new apparatus for which there is a small demand. Special work has, however, been carried out for Government Departments. The Towers Model 75 Analytical Balance is being made in increasing numbers and is proving most popular. Repeat orders have been received from many laboratories. This balance is designed to give a long life and maintain its sensitivity. It is fitted with a new type of double arrestment which gives very smooth action and protects the knife-edges. Analytical weights are also being turned out in larger quantities. A full range of hydrometers in the Towers Streamline pattern are made which are meeting an ever increasing demand for instruments of guaranteed accuracy. Dreadnought glass pipe lines with the Towers patent ebonite tube connectors are helping in the production of explosives, pure chemicals, food products, etc. Transparency, corrosion resistance, and the saving of metal alloys are important advantages. The manufacture of pure acids and

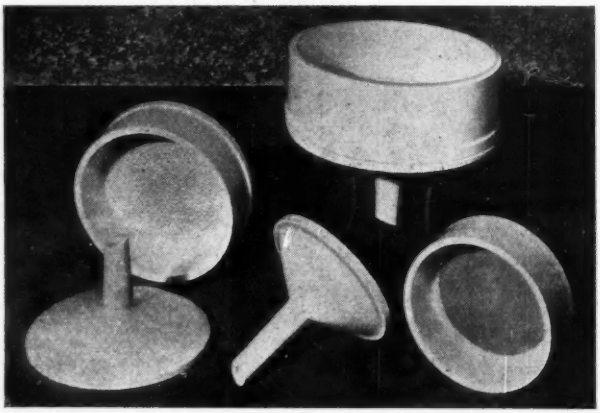


Fig. 2. (left) Doulton white stoneware Buchner funnels : on the left, standard Buchner top with perforated base ; the pattern on the right has a porous ceramic plate (of integral construction with the remainder of the top) in place of the usual perforations.

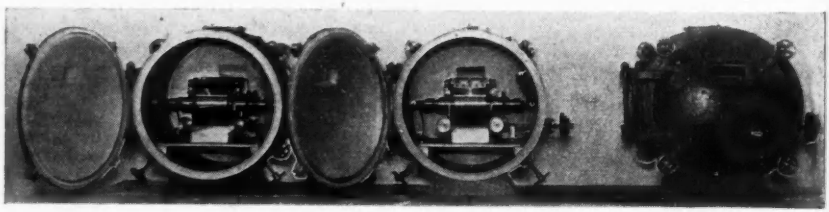


Fig. 3. (below) Small film drum dryer with vacuum casings, by L. A. Mitchell, Ltd.

chemicals, lampblown glassware, graduated glassware, electric ovens and furnaces, gas identification sets, and many other items continue at their Widnes works. Their branches at Manchester and Liverpool have also been very fully occupied supplying the requirements of laboratories in these districts.

New Type Funnels

In white chemical stoneware, two new types of Buchner funnels are now being manufactured by Doulton and Co., Ltd., of Lambeth, which overcome some of the drawbacks of large funnels. The two major disadvantages of the larger-sized Buchner funnels are: (1) the perforated plate is liable to collapse under extremes of vacuum and temperature (especially if these are combined); and (2) the underside of the perforated plate and the adjacent interior walls have to be left unglazed, because of manufacturing difficulties. The Doulton White Stoneware Buchner funnels overcome both these drawbacks. The stoneware "body," which is best described as "semi-porcelaneous" has a good resistance to mechanical and thermal shock, besides being proof against all corrosive liquids (hydrofluoric acid and hot, strong caustic alkalis alone excepted). This material permits a much more robust form of construction than is possible with porcelain, and, by making the funnels in two pieces which are afterwards carefully ground and fitted together, it is possible to glaze the inside surfaces. One pattern consists of a standard Buchner top, with perforated base, as shown on the left of Fig. 2. The other pattern seen on the right, has a porous ceramic plate (of integral construction with the remainder of the top) in place of the usual perforations. These porous-bottom funnels are excellent where large quantities of the same sort of liquor have to be handled, the porous part replacing the more customary filter paper. Three standard porosities are stocked and special pore sizes can be produced to meet specific requirements.

Torsion Viscometer

The Technico Universal Torsion Viscometer made by A. Gallenkamp & Co., Ltd., first appeared on the market just over two years ago. It is now used in a large number of different industries for the determination of viscosity and thixotropy of materials ranging from condensed milk to paint. The instrument consists of a metal cylinder which is suspended in the sample liquid by means of a torsion wire, which is attached at its upper end to an adjustable torsion head at the top of the instrument. At the lower end of the wire is a flywheel disc with a pointer fixed on the edge reading on a circular scale graduated 0-360° C. The torsion cylinder is supported from the lower side of the flywheel, and the zero point of the circular scale is fitted with a stop and release pin which engages the pointer on the flywheel. The viscosity of a sample is determined by the slowing down effect it has on the suspended cylinder, the position at which the pointer comes to rest when the cylinder is rotated giving a measure of the viscosity. Graphs provided with the instrument enable the viscometer readings to be converted into Redwood Seconds units, within an accuracy of a few per cent. The determinations take only a few minutes each so that no thermostatically controlled bath is necessary to prevent temperature changes, while the results are not affected in any way by foreign matter or solid particles in suspension so that samples do not require to be purified as in the use of a flow viscometer. The instrument is cheap and robust, has no delicate parts to get out of order, and torsion wires and cylinders can be replaced at small cost. The modified instrument with graduated torsion head can be used either as an ordinary viscometer or for the determination of thixotropy. Its range is 100 to 200,000 Redwood Seconds.

Fig. 4. The "Technico" torsion viscometer.

CHEMICALS IN POLAND

Drastic rationalisation of the chemical industry in Poland is taking place. All raw materials required by the chemical and pharmaceutical industries (including soap, glass, cellulose, glue, and resin factories) as well as for the distribution of the finished products to retailers, are being officially organised. The reorganisation has been completed of the "Galikol" Chemische und Nährungsmittelbetriebe, a company which formerly consisted of several hundred small chemical and other co-operatives, centralised under the name of "Chemia." In March last the formation of a cartel for the carbonic acid industry was announced, with functions including the regulation of sales and prices, and also of an "Arbeitsgemeinschaft" for the rationalisation of the hollow glass industry.

Liquid Level Control

Two Electrodes : Danger Hazard Removed

A PATENTED system of floatless liquid level control called "Lectralevel" has been recently introduced by Londex, Ltd., of 207 Anerley Road, London, S.E.20. It employs only one mercury switch for the control of the pump motor starter and is designed more particularly for the automatic pumping out, filling, or maintaining the liquid level in a container. If the pump suction pipe is earthed and used as one side of the control circuit, only one wire is necessary from the electrodes to the relay, and this circuit works with a maximum open circuit voltage of 25 volts, so that dangerous shocks are impossible. The 25-volt supply is derived from a small double wound transformer working off power or lighting mains, and the relay pilot circuit to the starter of the motor may be at any commercial voltage.

A special point is made about the use of two electrodes and it will be observed that the control circuit is completed through the liquid to be pumped. Owing to the low voltage of the circuit, however, no elaborate insulation is required for the electrode holders and the electrodes themselves may be satisfactorily made by using ordinary galvanised wrought-iron gas tubing. The shorter electrode is connected direct to the relay and when the liquid level rises to make contact with this electrode the relay operates and the motor is started. The longer electrode is connected by the same lead to the relay, but through a resistance of a few ohms. Its function is to pass sufficient current through the relay to hold the latter closed after the liquid level has dropped away from the short electrode. When finally the liquid level drops beyond the longer electrode the relay circuit is interrupted and the motor automatically stops; but the motor is not restarted when the liquid level rises again to the longer electrode, because more current is required to close the relay than to hold it closed, and the additional resistance in series with the long electrode does not allow enough current to pass to attract the relay until the liquid level reaches the short electrode, which does not have the additional resistance in series with it.

The normal type of relay employed is that known as the Londex "LQA" (Fig. 2), the mercury switch of which is suitable to carry up to 20 A. at 440 volts for the control of the motor starter. The arrangement outlined is almost as simple as it can be made and secures reliable control without the use of floats or any attendance. For cases where the liquid is under pressure or where insulated electrodes cannot be employed conveniently, the firm offers a patented automatic liquid level control device of the induction type, wherein a float is employed to alter the magnetic conditions in two coils which respectively operate relays at high and low water levels. This equipment is most suitable for liquids and their gases where it may be dangerous for them to come into contact with atmospheric air, *e.g.*, high pressure water, liquid air, freon, ammonia, acids, high explosive mixtures, benzene, ether, naphtha, petrol, etc. Other Londex products are available in considerable variety for functions connected with the indication and control of liquid flow.

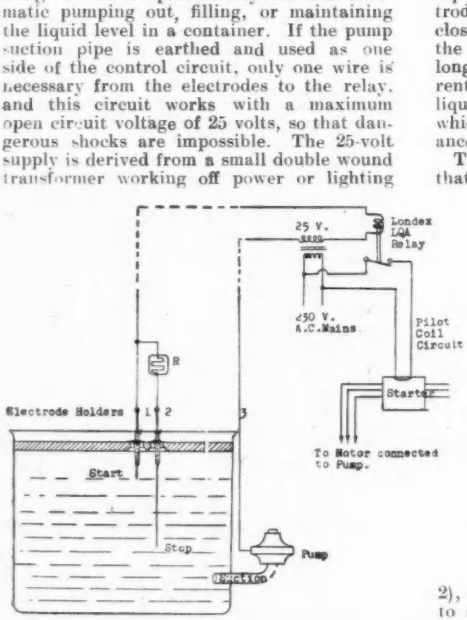


Fig. 1 (left). The working principle of "Lectralevel" system. Fig. 2 (above). A Londex relay "LQA."

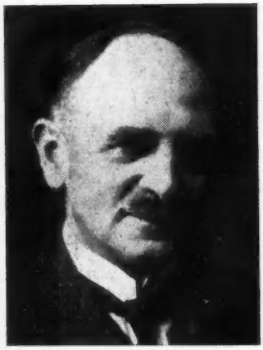
Personal Notes

The control of mica will in future be exercised by a special section of the Non-Ferrous Metals Control, under MR. G. F. A. BURGESS as Controller. All communications relating to requirements of mica should be addressed to the Mica Control, South Wing, Somerset House, London, W.C.2.

MR. N. A. BENNETT has been elected chairman of the London section of the Oil and Colour Chemists' Association in succession to DR. H. W. KEENAN. The Section has appointed the following officers: MR. DAVID E. ROE (hon. secretary), MR. G. W. READ BAKER (hon. treasurer), MR. H. A. IDLE (hon. publications secretary), MR. E. D. WILSON (hon. auditor).

SIR GEORGE NELSON, chairman and managing director of the English Electric Co., Ltd., and vice-president of the British Electrical and Allied Manufacturers' Association, was last week elected President of the Federation of British Industries in place of Lord Dudley Gordon, who retired from the presidency after holding office for three years.

MR. F. A. GREENE, M.I.Mech.E., M.I.E.E., M.I.Chem.E., Membre de la Société des Ingénieurs Civils de France, whose portrait



Mr. F. A. Greene.

we publish to-day, was, as already reported, recently elected president of the Institution of Chemical Engineers. He was educated at Merchant Taylor's School and King's College, London, became a Jelf Medallist and was afterwards made a fellow of the college. He started as a consultant in 1906, specialising in mine ventilating, paper, explosives, chemicals, leather, and fibre, after serving as a pupil with the firm of Henry Greene and Company. During the last war he was connected with the Ministry of Munitions, and he has been honorary treasurer of the Institution of Chemical Engineers since 1929.

DR. E. W. SMITH, C.B.E., D.Sc., F.I.C., M.I.Chem.E., has been elected President of the Institute of Fuel for 1943/44. He will take office in October. Dr. Smith was chief chemist at the Birmingham Corporation Gas Department for several years before becoming technical director of the Woodall Duckham Companies some twenty years ago. In 1941 he was appointed Director General of Gas Supply, which position he continued to hold until, having completed the work for the Government that he had undertaken to do, he resigned a few weeks ago.

SIR DAVID MILNE-WATSON has resigned, on his doctor's orders, from the presidency of the National Gas Council and the chairmanship of the Central Executive Board. He has been connected with the National Gas Council since 1916, when he was elected chairman of the newly formed Council. In 1919 he was chosen unanimously as president of the reconstituted National Gas Council of Great Britain and Ireland. His successor as president of the Council will be appointed at the annual meeting of the Council on June 8.

The award of the Edward Medal to WILSON C. G. BALDWIN, WILLIAM SALLOWS, and FRANK H. WHEELER, announced in the *London Gazette*, marks an act of great gallantry by which the most serious consequences of an explosion were averted. Following an explosion in a building in which explosives were being mixed, great damage was caused to a nitrating house in which nitro-glycerine was being prepared. Although the building was filled with fumes and steam, Mr. Wheeler and Mr. Sallows took prompt steps to control the nitration, in which they were assisted by Dr. Baldwin, the works manager. Between them they also extinguished a dangerous outbreak of fire above a pre-wash tank, and prevented a further explosion which would inevitably have caused a great number of casualties.

Obituary

MR. ERNEST C. HUGHES, M.Sc., director of Hughes & Treleaven, Ltd., printers' ink manufacturers, Liverpool, died on April 13, at the age of 55. Before joining the family firm he had served as senior chemist with Price's Candle Company, at Bromborough and London.

PROFESSOR F. P. BEDSON, Professor of Chemistry at Armstrong College, Newcastle-on-Tyne until his retirement in 1921, has died, at the age of 90. Professor Bedson came to Newcastle from Manchester in 1882 and began chemical research into problems connected with the mining industry. In acknowledgment of his work in connection with explosive gases in the mine, he was made an honorary member of the Institution of Mining Engineers.

Prices of British Chemical Products

STRONG price conditions continue to be the chief feature of the industrial chemicals market and a fair amount of new business has been reported. In most sections, however, there has been very little material on offer, since available supplies are mostly absorbed by deliveries under existing contracts. Values generally are unchanged at recent levels, the undertone, however, remains strong. Among the potash materials, offers of yellow prussiate of potash and caustic potash are being carefully distributed to approved consumers, and there is a steady request for the technical and pharmaceutical grades of permanganate of potash. Home-produced permanganate of potash is still in good call at recent levels. Good business is being transacted in the soda products section, particularly in respect of nitrate of soda and soda ash. Supplies of chlorate of soda, yellow prussiate of soda, and bicarbonate of soda are insufficient to meet current demands, while Glauber salt and salt cake remain steady. Conditions in the coal-tar products market remain more or less the same as reported last week.

MANCHESTER.—The Lancashire and Yorkshire textile and allied trades were reported on the Manchester chemical market during the past week to be taking fair aggregate quantities of a wide range of heavy chemicals, still principally against contracts, while in this respect steady trading conditions obtain in most of the other industrial outlets. Fresh inquiry during the past week has been reported in some of the alkalis, while in the acid section most classes of materials are meeting with a steady demand, as are also the ammonia and magnesia compounds. The demand for the light coal-tar products generally keeps up at a good level, and a steady trade is being done in crude tar and creosote oil.

GLASGOW.—In the Scottish heavy chemical trade there is no change from last week, home business remaining steady. Export trade remains very limited. Prices continue to be firm.

Price Changes

Rises: Aluminium sulphate; potassium nitrate; sodium nitrite; sodium prussiate; xylol (highest grade).

Falls: Cresylic acid, 99.5/100%; lead acetate.

General Chemicals

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton £39 10s.; 10 cwt./ 1 ton, £40 10s., 4/10 cwt., £41 10s.; 80% pure, 1 ton, £41 10s.; 10 cwt./1 ton, £42 10s.; 4/10 cwt., £43 10s.; commercial glacial, 1 ton, £49; 10 cwt./1 ton, £50; 4/10 cwt., £51; delivered buyers' premises in returnable barrels, £4 10s. per ton extra if packed and delivered in glass.

Acetone.—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

Alum.—Loose lump, £14 10s. per ton, f.o.b.

Aluminium Sulphate.—£10 15s. to £11 15s. per ton d/d.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Carbonate.—£38 to £39 per ton d/d in 5 cwt. casks.

Ammonium Chloride.—Grey galvanising £22 10s. per ton, in casks, ex wharf. Fine white 98%, £19 10s. per ton. See also Salammoniac.

Antimony Oxide.—£111 to £117 per ton.

Arsenic.—For 1-ton lots, £41 to £46 per ton, according to quality, ex store. Intermediate prices for intervening quantities.

Barium Carbonate.—MANCHESTER: precip. (4-ton lots), £16 per ton d/d.

Barium Chloride.—98/100%, prime white crystals, £16 10s. to £19 10s. per ton, bag packing, ex works.

Bleaching Powder.—Spot, 35/37%, £11 to £11 10s. per ton in casks, special terms for contract.

Borax, Commercial.—Granulated, £31 10s.; crystals, £32 10s.; powdered, £33; extra fine powder, £34; B.P. crystals £40 10s.; powdered, £41; extra fine, £42 per ton for ton-lots, in free 1-cwt. bags, carriage paid in Great Britain. Borax Glass, lump, £83; powder, £84 per ton in tin-lined cases for home trade only, packages free, carriage paid.

Boric Acid.—Commercial, granulated, £52 15s.; crystals, £53 15s.; powdered, £54 15s.; extra fine powder, £56 15s.; B.P. crystals, £61 15s.; powdered, £62 15s.; extra fine powdered, £64 15s. per ton for ton lots in free 1-cwt. bags, carriage paid in Great Britain.

Calcium Bisulphite.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid, £5 15s. per ton, ex store.

Charcoal, Lump.—£10 10s. to £14 per ton, ex wharf. Granulated, supplies scarce.

Chlorine, Liquid.—£23 per ton, d/d in 16/17 cwt. drums (3-drum lots).

Chrometan.—Crystals, 5½d. per lb.

Chromic Acid.—1s. 5d. per lb., less 2½%, d/d U.K.

Citric Acid.—Controlled prices per lb., d/d buyers' premises. For 5 cwt. or over, anhydrous, 1s. 6¾d., other, 1s. 5d.; 1 to 5 cwt., anhydrous, 1s. 9d., other, 1s. 7d. Higher prices for smaller quantities.

Copper Oxide.—Black, £95 per ton.

Copper Sulphate.—£31 5s. per ton, f.o.b., less 2 per cent. in 2 cwt. bags.

Cream of Tartar.—100%, £18 12s. per cwt., less 2½%, d/d in sellers' returnable casks.

Formaldehyde.—£24 10s. to £26 per ton in casks, according to quantity, d/d. MANCHESTER: 40%, £24 10s. to £26 10s. per ton in casks, according to quantity, d/d.

Formic Acid.—85%, £47 per ton for ton lots, carriage paid; smaller parcels quoted up to 50s. per cwt., ex store.

Glycerine.—Chemically pure, double distilled 1260 s.g., in tins, £4 to £5 per cwt., according to quantity; in drums, £3 14s. 6d. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

Hydrochloric Acid.—Spot, 6s. 5½d. to 8s. 11d. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Iodine.—Resublimed B.P., 10s. 4d. to 14s. 6d. per lb., according to quantity.

Lactic Acid.—Pale tech., 43½ per cent. by weight, £49 per ton; dark tech., 43½ per cent. by weight, £42 per ton ex works; barrels returnable carriage paid.

Lead Acetate.—White, 50s. 6d. to 52s. 6d. per cwt. MANCHESTER: £51 to £54 per ton.

Lead Nitrate.—About £47 per ton d/d in casks.

Lead, Red.—English, 5/10 cwt., £44 10s. per ton; 10 cwt. to 1 ton, £44 5s.; 1/2 tons, £44; 2/5 tons, £43 10s.; 5/20 tons, £43; 20/100 tons, £42 10s.; over 100 tons, £42 per ton, less 2½%, carriage paid, non-setting red lead, 10s. per ton dearer in each case.

Lead, White.—Dry English, less than 5 tons, £57; 5/15 tons, £53; 15/25 tons, £52 10s.; 25/50 tons, £52; 50/200 tons, £51 10s. per ton; less 5%, carriage paid; Continental material, £1 per ton cheaper Ground in oil, English, 1/5 cwt., £68 10s.; 5/10 cwt., £67 10s.; 10 cwt. to 1 ton, £67; 1/2 tons, £65 10s.; 2/5 tons, £64 10s.; 5/10 tons, £62 10s.; 10/15 tons, £61 10s.; 15/25 tons, £60 10s.; 50/100 tons, £60 per ton, less 5% carriage paid.

Litharge.—1 to 2 tons, £44 10s. per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £18 15s. to £22 15s. per ton.

Magnesium Chloride.—Solid (ex wharf), £16 to £18 per ton. MANCHESTER: £14 to £16 per ton.

Magnesium Sulphate.—Commercial, £12 to £14 per ton, according to quality, ex works.

Mercury Products.—Controlled price for 1 cwt. quantities: Bichloride powder, 15s. 8d.; bichloride lump, 16s. 3d.; ammon. chloride powder, 17s. 10d., ammon. chloride lump, 17s. 8d.; mercurous chloride, 18s. 7d.; mercury oxide, red cryst, 20s. 9d.; red levig., 20s. 3d.; red tech., 19s. 11d.; yellow levig., 20s. 2d.; yellow tech., 19s. 7d.; sulphide, red, 17s. 9d.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 2s. 4d. per gal.; pyridinised 64° O.P. 100 gals., 2s. 5d. per gal.

Nitric Acid.—£24 to £26 per ton, ex works.

Oxalic Acid.—£60 to £65 per ton for ton lots, carriage paid, in 5-cwt. casks; smaller parcels would be dearer; deliveries slow.

Paraffin Wax.—Nominal.

Potash, Caustic.—Basic price for 50-100 ton lots. Solid, 88/92%, commercial grade, £53 7s. 6d. per ton, c.i.f. U.K. port, duty paid. Broken, £5 extra; flake, £7 10s. extra; powder, £10 extra per ton. Ex store, £3 10s. supplement. Liquid, d/d, £34 in lots of 1 ton.

Potassium Bichromate.—Crystals and granular, 7¾d. per lb.; ground, 8¾d. per lb., for not less than 6 cwt.; 1-cwt. lots, ¼d. per lb. extra.

Potassium Carbonate.—Basic prices for 50 to 100 ton lots: calcined, 98/100%, £52 10s. per ton, c.i.f. U.K. port. Ex warehouse, £55 5s. per ton.

Potassium Chlorate.—Imported powder and crystals, nominal.

Potassium Iodide.—B.P., 8s. 8d. to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, 64s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 10d. per lb. for 1 cwt. lots; for 3 cwt. and upwards, 1s. 9½d. per lb.; technical, £7 18s. 6d. to £8 10s. 6d. per cwt., according to quantity d/d.

Potassium Prussiate.—Yellow, 5 cwt. to 7 cwt., casks, 1s. 6d. per lb., d/d; supplies scarce.

Salammoniac.—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £19 10s. per ton, in casks, ex store.

Soda, Caustic. — Solid 76/77%; spot, £16 7s. 6d. per ton d/d station.

Sodium Acetate.—£41 per ton, ex wharf.

Sodium Bicarbonate.—Refined, spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 6¼d. per lb.; anhydrous, 6¼d. per lb., net, d/d U.K.

Sodium Bisulphite Powder.—60/62%, £19 10s. per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£21 per ton d/d in minimum ton lots in 2 cwt. free bags.

Sodium Chlorate.—£36 to £45 per ton, d/d, according to quantity.

Sodium Hyposulphite.—Pea crystals, £20 per ton for 2-ton lots; commercial, £15 per ton; photographic, £22 per ton.

Sodium Iodide.—B.P., for not less than 28 lb., 9s. 11d. per lb., for not less than 7 lb., 13s. 1d. per lb.

Sodium Metasilicate.—£16 per ton, d/d U.K. in 1-ton lots.

Sodium Nitrite.—£20 to £23 10s. per ton for ton lots.

Sodium Percarbonate.—21½% available oxygen, £7 per cwt.

Sodium Phosphate.—Di-sodium, £20 to £25 per ton d/d for ton lots. Tri-sodium, £26 to £30 per ton d/d for ton lots.

Sodium Prussiate.—8¾d. to 9½d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Sulphate (Glauber Salts).—£4 10s. ton d/d.

Sodium Sulphate (Salt Cake).—Unground. Spot £4 11s. per ton d/d station in bulk. MANCHESTER: £4 15s. per ton d/d station.

Sodium Sulphide. — Solid, 60/62%, spot, £17 15s. per ton, d/d, in drums; crystals, 30/32%, £12 7s. 6d. per ton, d/d, in casks.

Sodium Sulphite.—Anhydrous, £29 10s. per ton; pea crystals, spot. £20 10s. per ton d/d station in kegs; commercial, £12 to £14 per ton d/d station in bags.

Sulphur.—Per ton, for quantities of not less than 4 tons; ground, but not sieved, £15 10s.; ground and sieved, £17 15s. Controlled prices.

Sulphuric Acid.—168° Tw., £6 10s. to £7 10s. per ton; 140° Tw., arsenic-free, £4 11s. per ton; 140° Tw., arsenious, £4 3s. 6d. per ton. Quotations naked at sellers' works.

Tartaric Acid.—4s. 4d. per lb., less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 4s. 4d. per lb.

Tin Oxide.—Snow white, 305s.-315s. per cwt.

Zinc Oxide.—Maximum prices: White seal, £30 17s. 6d. per ton; red seal, £28 7s. 6d. d/d; green seal, £29 17s. 6d. d/d.

Zinc Sulphate.—Tech., £20-£21 per ton, carriage paid, casks free.

Rubber Chemicals

Antimony Sulphide.—Golden, 1s. 2d. to 2s. 1½d. per lb. Crimson, 2s. 2d. to 2s. 6d. per lb.

Arsenic Sulphide.—Yellow, 1s. 9d. per lb.

Barytes.—Best white bleached, £8 3s. 6d. per ton.

Cadmium Sulphide.—6s. to 6s. 6d. per lb.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Bisulphide.—£34 per ton, according to quality, in free returnable drums.

Carbon Tetrachloride.—£46 to £49 per ton.

Chromium Oxide.—Green, 2s. per lb.

India-rubber Substitutes.—White, 6 3/16d. to 10¼d. per lb.; dark, 6 3/16d. to 6 15/16d. per lb.

Lithopone.—30%, £25 per ton; 60%, £31 to £32 per ton. Imported material would be dearer.

Mineral Black.—£7 10s. to £10 per ton.

Mineral Rubber, "Rupron."—£20 per ton.

Sulphur Chloride.—7d. per lb.

Vegetable Lamp Black.—£49 per ton.

Vermilion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.
Plus 5% War Charge.

Nitrogen Fertilisers

Ammonium Phosphate Fertilisers.—Type B, See Concentrated Fertilisers.

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, August, £9 10s.; increased charge of 1s. 6d. per month up to March, 1943.

Calcium Cyanamide.—Nominal; supplies very scanty.

Concentrated Fertilisers.—Per ton in 6-ton lots d/d farmer's nearest station, in August: I.C.I. Type, "Special III," £14 9s. 6d.; Type "B," £14 1s. 3d.; Type "C," £17 19s. Increased charge of 1s. 6d. per month up to March, 1943.

"Nitro Chalk."—£9 14s. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean super-refined for 6-ton lots d/d nearest station, £15 5s. per ton; granulated, over 98%, £14 10s. per ton. Surcharges for smaller quantities unless collected at warehouse or depots.

Coal Tar Products

Benzol.—Crude, 60's, 1s. 11d.; pure, 2s. 6d., per gal., ex works.

Carbolic Acid.—Crystals, 9½d. to 11½d. per lb. Crude, 60's, 4s. 3d. to 4s. 6d., according to specification. MANCHESTER: Crystals, 9½d. to 11½d. per lb., d/d; crude, 4s. to 4s. 6d., naked, at works.

Creosote.—Home trade, 6½d. per gal., f.o.r., maker's works; exports, 6d. to 6½d. per gal., according to grade. MANCHESTER: 6½d. to 9d. per gal.

Cresylic Acid.—Pale, 97%, 3s. 6d. per gal.; 99%, 4s. 2d.; 99.5/100%, 4s. 4d. MANCHESTER: Pale, 99/100%, 4s. 6d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 8d. per gal. for 1000-gal. lots; heavy, 90/190°, 2s. 2d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Naphthalene.—Crude, in 4-ton lots, in sellers' bags, £5 9s. to £8 9s. per ton, according to m.p.; hot-pressed, £10 5s. per ton; purified crystals, £19 to £35 per ton. Controlled prices.

Pitch.—Medium, soft, 45s. to 55s. per ton, f.o.b. MANCHESTER: 46s. per ton, at works.

Pyridine.—90/140°, 18s. per gal.; 90/160°, 13s. to 14s. MANCHESTER: 14s. to 18s. 6d. per gal.

Toluol.—Pure, 2s. 5d. nominal; 90's, 1s. 10d. per gal. MANCHESTER: Pure, 2s. 5d. per gal. naked.

Xylol.—For 1000-gal. lots, 3s. 1½d. to 3s. 4½d. per gal., according to grade, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Wood Distillation Products

Calcium Acetate.—Brown, £21 per ton; grey, £24. MANCHESTER: Grey, £24 to £25 per ton.

Methyl Acetone.—40/50%, £56 per ton.

Wood Creosote.—Unrefined, about 2s. per gal., according to boiling range.

Wood Naphtha, Miscible.—4s. 6d. to 5s. 6d. per gal.; solvent, 5s. 6d. per gal.

Wood Tar.—£5 per ton.

Intermediates and Dyes (Prices Nominal)

m-**Cresol** 98/100%.—Nominal.

o-**Cresol** 30/31° C.—Nominal.

p-**Cresol** 34/35° C.—Nominal.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb; 66/68° C., 1s.

p-**Nitraniline.**—2s. 5d. per lb.

Nitrobenzene.—Spot, 5½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyer's works.

Nitronaphthalene.—1s. 2d. per lb.; P.G., 1s. 0½d. per lb.

o-**Toluidine.**—1s. per lb., in 8/10 cwt. drums, drums extra.

p **Toluidine.**—2s. 2d. per lb., in casks.

m-**Xylidine Acetate.**—4s. 5d. per lb., 100%.

Latest Oil Prices

LONDON. — April 21. — For the period ending May 1, per ton, net, naked, ex-mill, works or refinery, and subject to additional charges according to package and location of supplies: LINSEED OIL, crude, £46 10s. RAPESEED OIL, crude, £54. COTTONSEED OIL, crude, £39 12s. 6d.; washed, £42 15s.; refined edible, £48; refined, deodorised, £49. COCONUT OIL, crude, £36 12s. 6d.; refined deodorised, £40. PALM KERNEL OIL, crude, £36; refined deodorised, £40; refined hardened deodorised, £44. PALM OIL, refined deodorised, £46; refined hardened deodorised, £49. GROUNDNUT OIL, crude, £44; neutralised and bleached, £48; refined hardened deodorised, £53 to £54. WHALE OIL, crude hardened, 42 deg., £39; refined hardened, 42 deg., £42. ACID OILS—Groundnut, £27 10s.; soya, £25 10s.; coconut and palm-kernel, £31. ROSIN, 26s. 6d to 33s. per cwt., ex wharf, according to grade. TURPENTINE, American, 87s. per cwt. in drums or barrels, as imported (controlled price).

General News

From Week to Week

Staff shortage is impairing the service of meals to war workers in their canteens, according to Mr. George Beardsworth, J.P., of the National Union of Distributive and Allied Workers, and chairman for the ensuing year of the National Joint Industrial Council for the Industrial Catering Trade.

A deputation of Conservative M.P.'s asked Major Lloyd George, Minister of Fuel and Power, to remove the Government control over one of the Welsh collieries belonging to the Point of Ayr Company, but he has ruled that control must stay until production does not suffer by its removal.

The Machinery, Plant, and Appliances (Control) (No. 4) Order, 1943 (S.R. and O. 1943, No. 536) issued by the Board of Trade, modifies the 1942 Order in respect of electrical machinery and plant, and, in addition, extends the general licence to the acquisition of carbon dioxide blasting equipment.

Any factory, whether engaged on munitions or any other essential work, can now be compelled to provide a factory canteen, if more than 250 employees are at work, in accordance with an amendment to the Factories (Canteens) Order, 1943. The amendment also provides a new procedure for intervention if the service provided is unsatisfactory.

Trades Councils throughout the country are recommending their members to increase their weekly contributions to the Red Cross Penny-a-Week Fund. More than a million regular contributors have already increased the amount of their weekly contribution to the Fund, one-quarter of which is being devoted to sending medical stores and clothing to Russia.

Sulphate of ammonia is short in all parts of England and Wales, according to complaints made at a recent council meeting of the National Farmers' Union. It was emphasised that unless nitrogen was made available within the next month, bumper crops of sugar beet and cereals could not be produced. Mr. C. Neville, chairman of the Union's commercial committee, promised to take up the matter urgently with the fertiliser control.

An Association of Scientific Photography has been formed to promote the advancement of photography in all branches of science. The organising secretary is Mr. R. McV. Weston (Houndwood, Farley, Salisbury, Wilts.). The association intends to establish an information bureau which will collate details of the varied applications of photography to research, industry, and teaching. Its committee includes S. Bovle, Photographic Section, I.C.I. Research Dept., and G. A. Jones, Kodak Research Dept.

Further comment on the shortage of persons with a scientific training in this country was made by Sir John Thornycroft, president of the Institution of Civil Engineers, at a luncheon of the Junior Institute of Engineers last week. He also referred adversely to the limited opportunities available for attending technical schools. Lord Sempill, from the chair, remarked on the achievement of scientists in the gas industry, whereby the efficient use of raw coal had been doubled.

200 chemists, physicists, metallurgists and engineers from industry, Government departments and universities attended the second Institute of Physics conference on X-ray Analysis at Cambridge, so demonstrating the growing field of application of this analytical method. Among the speakers was Mr. C. W. Bunn, of I.C.I., who gave a stimulating address with the title "Towards Atomic Photography." Photographs, models, and apparatus were exhibited in the Cavendish and the Crystallographic laboratories.

Co-operation in North, West, and East Europe, and immediate relief after the war, were the chief subjects of discussion at a recent conference of the Division for the International Relations of Science of the British Association under the title of "Co-operative Systems in European Agriculture." The speakers, who included Sir John Russell, Dr. C. R. Fay, M. André Philip, and scientists from Belgium, Norway, Denmark, Czechoslovakia, and elsewhere, emphasised the need for co-operation in buying as well as selling.

From April 18, capsules and tablets made from specially concentrated fish-liver oils have been available for expectant mothers, under the Vitamin Scheme. Each capsule (or tablet) contains 4000 International Units of vitamin A and 800 I.U. of vitamin D. They will not be available to children receiving fruit juice and cod-liver oil under the Vitamin Scheme. Future supplies of cod-liver oil under the scheme will contain double the present quantity of vitamin D. The new oil will, therefore, have a minimum vitamin D potency of 200 I.U. per gramme.

Foreign News

Ventura bombers attacked a chemical works at Ostend on April 16.

Uganda is experimenting in the manufacture of producer-gas units, in order to save petrol.

A Labour Department is in the making in Uganda. Its tasks will include a survey of African man power and the securing of labour for essential products such as rubber, sugar, sisal, and pyrethrum.

More vitamin A and D are found in liver-oils of certain S. African fish than in cod liver oil. Until recently it was customary to return to the sea all the inedible varieties of fish brought up by deep-sea trawlers, but with the development of a S. African fish by-products industry this practice has ceased and even man-eating sharks are now utilised.

Cottonseed oil, the only vegetable oil produced in important quantities in Peru, was approximately equal in output in that country in 1941 and 1942—about 18,150 metric tons, according to the American Press. Exports to Europe of cottonseed cake have recently been very small, owing to the shipping shortage.

Of the four power alcohol distilleries already reported as being under construction in Australia, that in New South Wales is nearest completion, and production will probably start there about June this year. The Western Australian plant will probably be ready next, with the Victorian and South Australian factories very close behind.

Under the Bleaching Powder and Chlorine Control Order, 1943, which came into force on February 10, the Government of India has prohibited the sale of bleaching powder or chlorine except by permit. No permit for civil purposes shall be issued until the requirements of defence orders and public health purposes have been met.

Glass ampoules used in Peru as containers for medicinal and injectable solutions must conform to the conditions prescribed in the 1937 edition of the French Codex Medicamentarius, and must be of neutral reaction or completely sterile. In the case of imported ampoules or containers, infringement of these rulings will lead to the prohibition of importation of such ampoules.

The Lend-Lease Administration has asked the U.S. Senate special silver committee to explore means of granting Britain's request for 3,250,000 ounces of lend-lease silver from the U.S. and 1,750,000 ounces from Canada. It is stated that the silver is to be returned at the end of the war, and that 5,000,000 ounces were desired by June, of which a third is for industry and two-thirds for coinage.

A new research laboratory has been opened at Easton, Pennsylvania, by the General Aniline and Film Corporation (formerly affiliated to I.G.). The 50 research workers employed will devote their efforts mainly to dyestuffs chemistry, though broader fields are to be explored in the near future. A number of patents based on work carried out in the I.G. laboratories remain to be developed commercially in the U.S.

The exploitation of a peat bog some twenty miles south of Johannesburg marks the opening of a new industry in South Africa. This deposit, from which several hundred tons of peat moss have already been recovered, is apparently unique, for although there may be others in the Union worthy of exploitation, the small quantities so far found in the Transvaal and the Cape forests around Knysna count for but little in the economic structure of the country.

Forthcoming Events

A meeting of the Midland section of the **Institution of the Rubber Industry** will be held on **April 29,** when Dr. D. Parkinson will read a paper on " The Effect of Diameter and Surface Area of Carbon Black Particles on Certain Properties of Rubber Compounds."

A lecture on " The Maintenance of Soil Fertility," the ninth in a series on agriculture to-day and to-morrow, will be given before the **Royal Society of Arts,** at 1.45 p.m., on **May 5,** by Mr. E. M. Crowther, D.Sc., F.I.C.

The Pilgrim Trust lecture of the **Royal Society** will take place in Burlington House, at 4.30 p.m., on **May 6.** The speaker, Dr. Karl T. Compton, will take as his subject, " The Organisation of American Scientists for the War."

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

ARLEE, LTD., Epsom, chemical manufacturers, etc. (M., 24/4/43.) March 30, £1550 debenture to H. L. Moore, London; general charge.

BI-METAL PRODUCTS, LTD., London, S.W. (M., 24/4/43.) March 20, series of £3000 debentures, present issue £55; general charge.

LOCKE, SPIER AND CO. (1928), LTD., Manchester, shellac and gum merchants. (M., 24/4/43.) March 25, charge to Cheshire Building Society securing £275 and any other moneys, etc., charged on 15 and 17 Plymouth Grove, Chorlton-on-Medlock. *Nil. August 28, 1940.

Company News

The United Turkey Red Co., Ltd., announce a profit for 1942 of £64,707.

Brontan, Ltd., have increased their nominal capital by the addition of £4000 in £1 ordinary shares beyond the registered capital of £1000.

Bryant and May, Ltd., announce a dividend of 10½ per cent. (10 per cent.), making 18½ per cent.. for the year ended March 31 (same).

Lewis Berger and Sons, Ltd.., have declared an interim dividend of 6 per cent. (same) on the ordinary shares, on account of the year to July 31, 1943.

New Companies Registered

Essex Carbide Tools, Ltd. (380,037).—Private company. Capital: £100 in 100 shares of £1 each. Manufacturers of tungsten, carbide, hard metals and allied metals and materials, engineers, tool makers, etc. Subscribers: R. T. A. Eley; L. W. Freeman. Registered office: 13 Orsett Road, Grays, Essex.

Dalmarnock Electrical and Engineering Co., Ltd. (22,371).—Private company, registered in Edinburgh. Capital: £200 in 200 shares of £1 each. Manufacturers, repairers, assemblers and installers of scientific and chemical units, etc. Directors: H. McGowan; J. McGowan. Registered office: 320 Nuneaton Street, Glasgow.

Universal Proofings, Ltd. (379,951).—Private company. Capital: £100 in 100 shares of £1 each. Chemists, manufacturers of and dealers in chemical, industrial and other preparations, wood pulp, paper, fabrics, paints, varnishes, preservatives and waterproofing preparations, etc. A. Frampton, Bromley Hill, Bromley, Kent, permanent director. Solicitors: J. and C. Dodd, 7 Stone Buildings, Lincolns Inn, W.C.2.

Chemical and Allied Stocks and Shares

SENTIMENT in Stock Exchange markets was assisted by encouraging views as to war developments, and, in accordance with the prevailing tendency, industrial securities were inclined to move higher in price. Imperial Chemical, at 38s. 9d. xd, were virtually unchanged on balance, allowing for deduction of the dividend from the price. On the basis of the 8 per cent. dividend the yield is moderate, but nevertheless, it compares favourably with the return on numerous other leading industrial shares. Lever & Unilever eased slightly to 35s. but on the other hand, Lever N. V. held their recent improvement to 30s. 6d. Borax Consolidated remained at 34s. 6d. and, awaiting the dividend announcement, British Match continued firm at 39s. Moreover, pending the results, Associated Cement held their improvement to 60s. Elsewhere, British Plaster Board were again 28s. 6d. A further small gain to 50s. was recorded in British Aluminium, and British Oxygen at 77s. were also higher on balance. Awaiting the results, Dunlop Rubber strengthened slightly to 34s. 6d., and General Refractories, which remained under the influence of the improved dividend, were firm at 16s. 1½d. At 66s. 3d. Nairn & Greenwich were well maintained. Barry & Staines at 41s. 6d. were also unchanged on balance.

Elsewhere, business up to 8s. was recorded in Greeff-Chemicals 5s. ordinary shares, and up to 47s. 6d. in Fisons, while, pending the dividend announcement, British Drug Houses continued to be quoted at 22s. Imperial Smelting were again 14s. In other directions, Tube Investments were maintained at 93s. 9d.; general expectations are that the interim dividend is likely to be unchanged. Awaiting the full results, Stewarts & Lloyds deferred have remained at 54s. 6d. at the time of writing, while Babcock & Wilcox kept at 51s. 3d. The dividend announcement of the last-named company is impending. Dorman Long regained an earlier small decline, and at 24s. 9d. were unchanged on balance. Cellon 5s. ordinary were again firm, awaiting the financial results, and transferred up to 19s. 9d. In other directions, Blythe Colour 4s. shares changed hands up to 7s. 10½d. At 7s. British Glues & Chemicals 4s. ordinary had the same quotation as a week ago. B. Laporte remained firmly held pending the dividend, and were again 78s. "middle." Monsanto Chemicals 5½ per cent. preference were again 22s. 6d., and William Blythe 3s. shares were quoted at 7s. 6d.

Goodlass Wall 10s. ordinary were well maintained at 13s. 4½d., while Lewis Berger were firm at 87s. on the maintenance of the interim dividend. Other paint shares were also firm, and Pinchin Johnson improved to 32s. 9d. on further consideration of the higher profits earned last year. Among securities of companies associated with plastics, Lacrinoid Products were 4s. 6d. British Industrial Plastics 2s. ordinary were again 5s. 10½d., and Erinoid 11s. 4½d. Elsewhere, Burt Boulton changed hands at 18s. 9d. Canning Town Glass 5s. shares were inclined to improve, awaiting the dividend, and transferred up to 8s. Key Glassworks changed hands at 60s. at one time, but Triplex Glass eased a few pence to 31s. 7½d.

Activity ruled in leading rayon shares; British Celanese were around 22s., while on balance Courtaulds improved from 49s. to 49s. 6d. Bradford Dyers, which remained under the hope that resumption of dividends may be in prospect for the current year, improved further from 16s. 9d. to 17s. Beechams Pills deferred were higher at 15s. 7½d. on yield considerations, while

Boots Drug maintained firmness at 41s. 6d. Among higher-priced securities, Turner & Newall improved to 75s. 6d., Metal Box to 86s. 9d., and elsewhere United Molasses 6s. 8d. units were better at 28s. 9d. Results of the last-named company are due shortly. Only minor movements have been shown in oil shares at the time of writing.

TAR DISTILLERS' ACTIVITIES

At its last meeting, the Executive Committee of the Association of Tar Distillers decided that the Coal-Tar Bituminous Products Sub-committee should pursue its investigations on coal-tar products in order to determine the maximum number of uses for which pitch, etc., could be recommended, to replace asphaltic bitumen. The Committee envisaged that this would be in the national interest from a long-term point of view, as designed to secure the maximum use of an indigenous material. The results of an investigation which is being conducted throughout the industry are to be examined at a series of special meetings of the Executive Committee with a view to formulating the basic principles on which the future policy of the industry could be determined. The Executive Committee is continuing its investigation into the depreciation allowances for income-tax purposes in respect of tar-distillation plant. The possibility of drawing up standard conditions of sale for pitch is being investigated.

PROFESSOR CONRAD ARNOLD ELVEHJEM, who occupies the Chair of Biochemistry at the University of Wisconsin, has this year been awarded the Willard Gibbs medal, for "eminent work in and original contributions to pure or applied chemistry," by the Chicago Section of the American Chemical Society. His studies have included trace elements in nutrition, and the chemistry of the vitamins, notably the vitamin-B complex.

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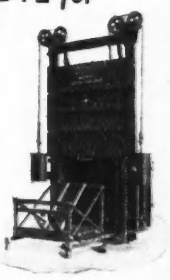

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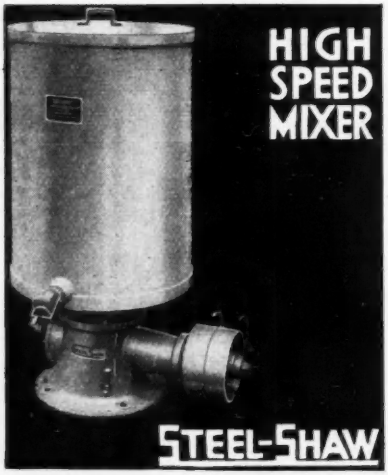

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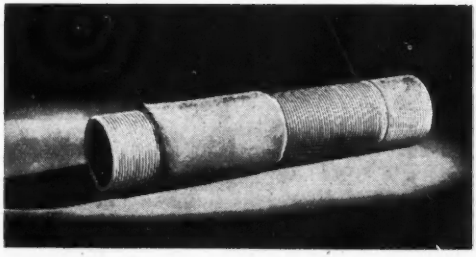

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Three—Vertical MILD STEEL STEAM JACKETED PANS, each 3 ft. 6 in. dia. by 2 ft. 8 in. deep, constructed from ⅜ in. plate and arranged with dished bottom.

One—Lead Lined STEAM JACKETED COPPER PAN, by H. J. West & Co., 4 ft. 0 in. dia. by 4 ft. 9 in. deep; 1½ in. bottom outlet; pan supported on four tubular legs.

One—Horizontal Wood Plate and Frame FILTER PRESS, forming 12 cakes, each 1 ft. 11 in. by 2 ft. 1 in. by 1 in. thick; side enclosed feed and enclosed simple washing ports; bottom side discharge; fitted taps; ratchet operated closing gear.

One—Horizontal Cast Iron Recessed Plate FILTER PRESS, by Johnson, having 9 plates with pyramid surface and 10 plates wih plain surface, forming 20 cakes each 12 in. square by ¼ in. thick; enclosed feed and discharge; hand-operated closing mechanism.

One—Copper STEAM JACKETED STILL by John Dore, 3 ft. 0 in. dia. by 4 ft. 6 in. deep, with 12 in. deep domed top; fitted horizontal gear driven agitator and complete with condenser.

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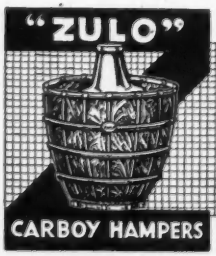

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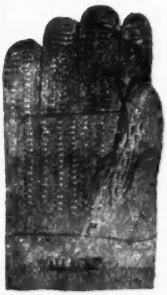

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